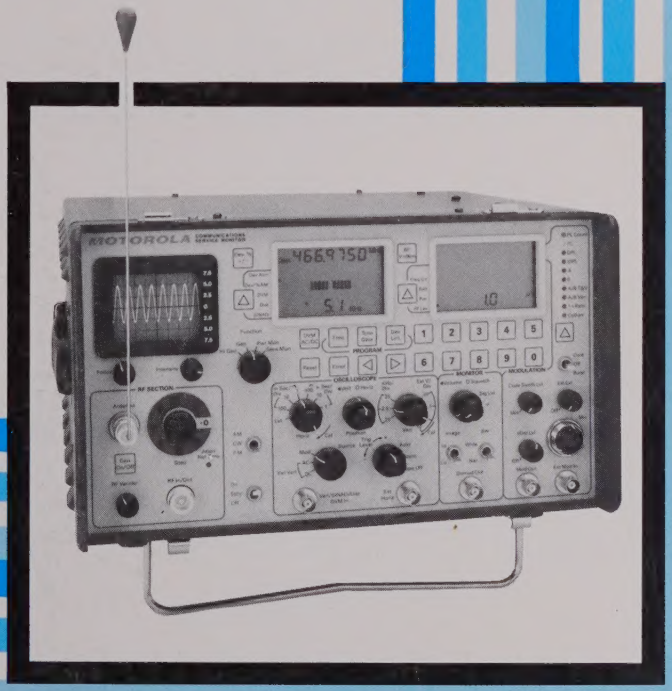
06223

MOTOROLA INC.

test equipment

Communications Service Monitor MAINTENANCE MANUAL



R-2200B

68P81069A69-O

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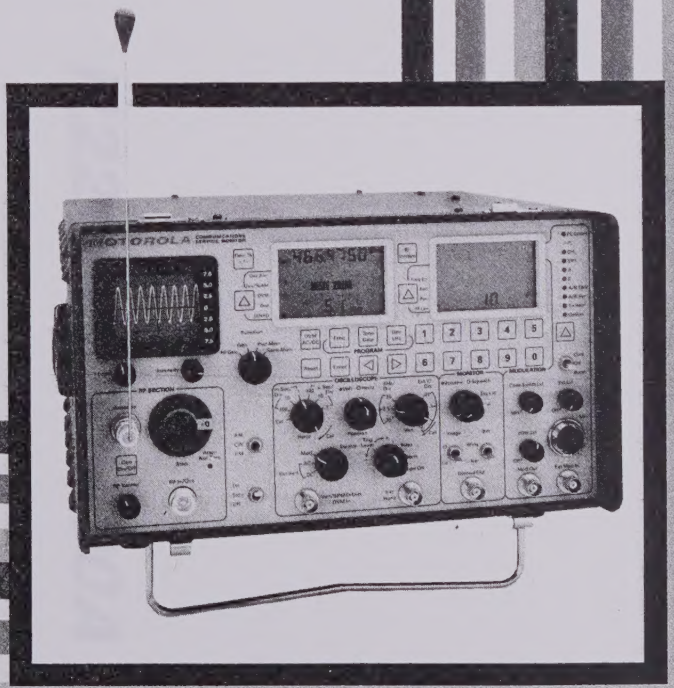

R-2200B

68P81069A69-O

MOTOROLA INC. R2200B/R2400A

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MOTOROLA INC.

instruction manual revision

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED:

68P81069A69-O	R2200B Communications Service Monitor Maintenance Manual

REVISION DETAILS:

Add the attached R2400A Communications Service Monitor with Spectrum Analyzer instruction section (68P81071E72-O) to your maintenance manual. This instruction section, together with the maintenance manual, provides the necessary data, diagrams, and parts lists required for the spectrum analyzer portion of the communications service monitor.

R2400A COMMUNICATIONS SERVICE MONITOR WITH SPECTRUM ANALYZER

NOTE

This instruction section **must** be used in conjunction with the R2200B Communications Service Monitor maintenance manual (68P81069A69).

1. DESCRIPTION

(Refer to figure 1.)

1.1 The RF interconnect (RFI) board receives a signal from the wideband amplifier board (WBA) that provides the on-channel signal centered at 10.7 MHz. This signal is mixed with a signal generated on the RFI board that is centered at 55.7 MHz and sweeps over an 8 MHz, 800 kHz or 80 kHz bandwidth. The result is that all signals in the 8 MHz, 800 kHz or 80 kHz bandwith, centered on the on-channel frequency, are swept through 45 MHz. This signal is then coupled to the spectrum analyzer I-F board.

1.2 The I-F board takes the swept 45 MHz output from the RFI board and converts the amplitude information to a dc voltage which is coupled to the vertical input of the oscilloscope. The resultant display shows the spectral content of the 45 MHz input over the given bandwidth (8 MHz, 800 kHz or 80 kHz).

2. LIST OF MAJOR ASSEMBLIES

A list of major assemblies, including Motorola kit number, is given in Table 1.

Table 1. List of Major Assemblies

Assembly/Subassembly Name	Motorola Kit Number
Rear Panel	—
Low Voltage Power Supply	RTP4018B
Scope Module	RTC1004B
High Voltage Board	RTP4019B
High Voltage Power Supply Board	RTP4020B
Driver Board	RTC4021B
Scope Amplifier Board	RTC4022A
RF Synthesizer Module	RTC1001CP
Digital Board	RTC4009B
RF Board	RTC4010C
Receiver Board	RTL4134B
Analog Interface Board	RTL4092B
CPU Board	RTC4023A
Counter Board	RTL4106A
RF Module	RTL1034A
Wideband Amplifier Board	RTL4204A
Wattmeter Board	RTL4094B
RF Interconnect Board	RTL4202A
Tone Synthesizer Board	RTL4096A
Reference/Audio Module	RTL4097A (TCXO)
Front Panel Interface Board	RTL4100A
Front Panel Display Board	RTL4101A
Chassis Mechanical Less Rear Panel and Main Interconnect Board	RTX1012A
Main Interconnect Board	RTL4099B
Front Panel	—
I-F Board	RTL4205A

3. FUNCTIONAL THEORY OF OPERATION

(Refer to Figure 1 and the appropriate schematic diagram.)

3.1 RF INTERCONNECT BOARD

3.1.1 10.7 MHz Circuity

The 10.7 ±4 MHz signal obtained from the WBA is amplified, buffered, low-pass filtered and applied to a mixer. A second input to the mixer is the 55.7 MHz swept injection signal.

3.1.2 55.7 MHz Swept Injection Signal

3.1.2.1 VOLTAGE CONTROLLED OSCILLATOR/ PHASE-LOCKED LOOP CIRCUITRY

The VCO is controlled by a parallel programmed PLL such that the average frequency is 55.7 MHz. A signal from the VCO is amplified and then frequency-divided by four. The PLL compares this signal with a signal derived from the 10 MHz reference. The PLL then sends a correction signal through an active loop filter to the VCO. The output of the VCO is then amplified, low-pass filtered, and applied to the mixer.

3.1.2.2. SWEEP CIRCUITRY

The VCO is frequency-swept by a ramp wave which is derived from the scope horizontal sweep signal. The scope horizontal ramp wave is either inverted, or not inverted, so that the VCO sweeps in the correct direction (depending on the position of the **Image Hi/Lo** switch on the front panel). Depending on the dispersion selected, the amplitude of the ramp wave is then set to one of three levels. The modified ramp is then applied to the VCO.

3.2 I-F BOARD

3.2.1 General

The I-F board consists of:

- A 45 MHz section which includes two stages of gain and four poles of crystal filtering.
- A custom IC which contains an active mixer, a local oscillator, three stages of gain, and a log amplifier.
- A switchable bandpass filter network and a 2-pole active filter/buffer.

3.2.2 45 MHz Section

The 45 MHz section is a two stage tuned I-F amplifier. The amplitude response of this section is displayed when the input to the spectrum analayzer is a CW signal. The 4-pole crystal filter determines the wide dispersion resolution bandwidth which is 36 kHz.

3.2.3 Custom IC

The custom IC (U101) takes the 45 MHz input at U101-11 and converts the input to a 455 kHz signal using the active mixer whose output is taken at U101-8. This signal is then coupled to the switchable bandpass filter network whose output is routed to the log amplifier input at U101-6. The log amplifier output is buffered and the output is then taken at U101-21.

3.2.4 Switchable Bandpass Filter Network

The switchable bandpass filter network is used to select the resolution bandwidth for the medium (100 kHz/div.) and narrow (10 kHz/div.) dispersions. The resolution bandwidths are 15 kHz and 6.5 kHz, respectively. When in the wide dispersion mode (1 MHz/div.), a resistive pad is switched in. This pad has the same insertion loss as the medium and narrow filters. The amplitude response of the filters, in the switchable network, is displayed when the input to the spectrum analyzer is a CW signal.

3.2.5 2-Pole Active Filter/Buffer

The output at U101-21 is coupled to a 2-pole Chebyshev low-pass active filter. This filter acts as a buffer and also removes any 455 kHz signal which may be present on the dc voltage at the log amplifier output.

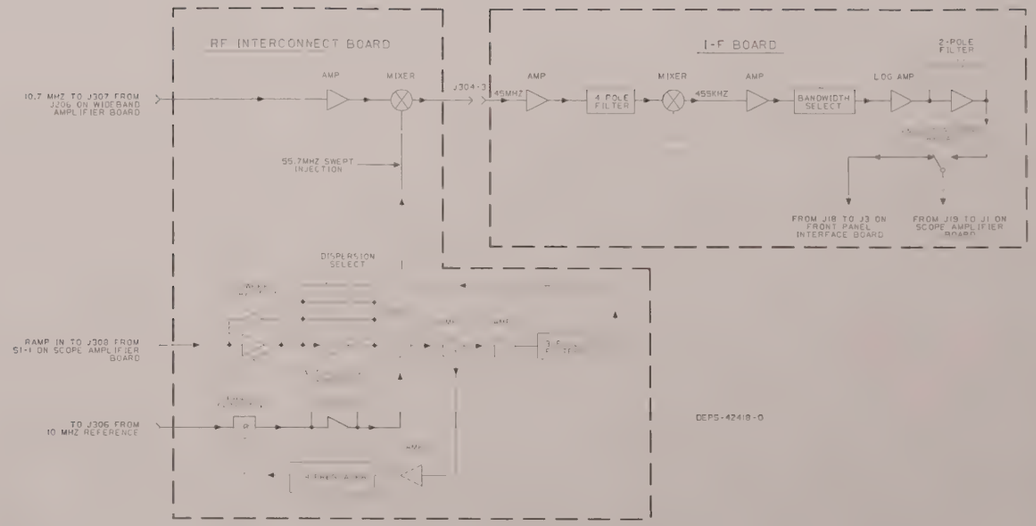
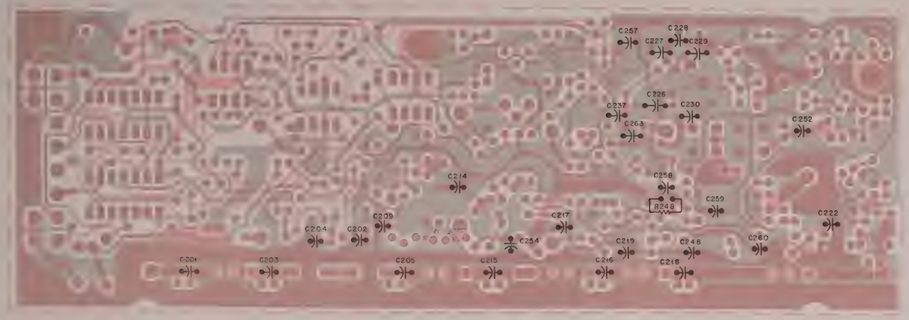


Figure 1. Spectrum Analyzer Functional Block Diagram

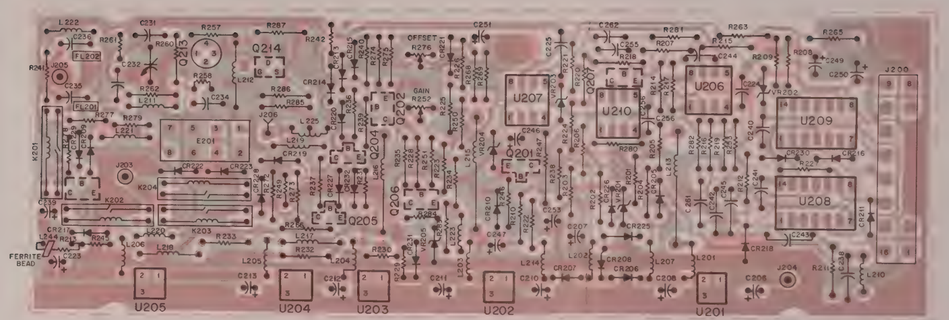
WIDEBAND AMPLIFIER

MODEL RTL4204A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



COMPONENT SIDE — BD-CEPS-42408-0 (REVERSED)
SOLDER SIDE — BD-CEPS-42409-0 (REVERSED)
OL-CEPS-42430-0

SHOWN FROM SOLDER SIDE
(COMPONENTS ARE A CHIP RESISTOR AND CHIP CAPACITORS)



J200 DETAIL

SW +5V	1	16	D.C REF & AUD IN
SW +5V	2	15	CAR & MOD LEVEL OUT
GND	3	14	ALC
GND	4	13	LO/HI BAND
GND	5	12	GEN
GND	6	11	HI GEN
+12V	7	10	SENSITIVE MONITOR
+12V	8	9	-12V

COMPONENT SIDE — BD-CEPS-42408-0
SOLDER SIDE — BD-CEPS-42409-0
OL-CEPS-42410-0

SHOWN FROM COMPONENT SIDE

parts list

RTL4204A Wideband Amplifier Board — PL-9834-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed (pF: ± 10%, 50 V (chip); unless otherwise stated
C201	21-80376A21	360
C202	21-80376A26	2200
C203	21-80376A21	360
C204	21-80376A26	2200
C205	21-80376A24	680
C206, 207, 208	23-83441B15	1 uF ± 20%; 35 V
C209	21-80376A26	2200
C210 thru 213	23-83441B15	1 uF ± 20%; 35 V
C214	21-80376A26	2200
C215	21-80376A24	680
C216	21-80378A19	270
C217	21-80376A26	2200
C218	21-80376A24	680
C219	21-80376A26	2200
C222	21-80376A25	1000
C223	23-84782H14	0.47 uF ± 20%; 50 V
C224	21-82428B21	.01 uF + 10-30%; 100 V
C225	21-82372C03	0.1 uF + 80-20%; 25 V
C226, 227		NOT USED
C228	21-11031A05	2.2
C229	21-11031A18	13
C230	21-11031A45	180
C231	21-82428B21	.01 uF + 10-30%; 100 V
C232	19-80376A35	variable, 9-35 pF
C233	21-84494B40	21 ± 5%; 500 V
C234	21-82428B21	.01 uF + 10-30%; 100 V
C235	21-84494B24	39 ± 5%; 500 V
C236	21-84494B06	120 ± 5%; 500 V
C237	21-11032A21	.01 uF
C238	21-82372C03	0.1 uF + 80-20%; 25 V
C239	23-83441B15	1 uF ± 20%; 35 V
C240, 241	21-82428B21	.01 uF + 10-30%; 100 V
C242, 243	23-82372C03	0.1 uF + 80-20%; 25 V
C244	21-82428B47	.002 uF ± 5%; 200 V
C245	21-82672C03	0.1 uF + 80-20%; 25 V
C246, 247	23-84665F51	10 uF + 100-10%; 25 V
C248	21-80376A26	2200
C249, 250	23-84665F08	15 uF + 100-10%; 25 V
C251	23-83441B15	1 uF ± 20%; 35 V
C252	21-80376A14	220 pF ± 2%
C253	23-83441B15	1 uF ± 20%; 35 V
C254	21-80376A27	.015 uF ± 10%
C255	21-82428B47	.002 uF ± 5%; 200 V
C256	21-82428B21	.01 uF + 10-30%; 100 V
C257	21-11032B13	0.1 uF + 80-20%
C258	21-80376A02	2.7 ± .25 pF
C259, 260	21-80376A26	2200
C261	21-82372C03	0.1 uF + 80-20%; 100 V
C262	21-82428B47	.002 uF ± 5%; 200 V
		diode: (see note)
CR205	48-83654H01	silicon
CR206, 207, 208	48-80345A82	pin
CR209, 210, 211	48-83654H01	silicon
CR212		NOT USED
CR213 thru 216	48-83654H01	silicon
CR217	48-80394A86	hot carrier
CR218, 219, 220	48-83654H01	silicon
CR221	48-80394A86	hot carrier
CR222, 223	48-83654H01	silicon
CR224		NOT USED
CR225 thru 230	48-83654H01	silicon
CR231	48-80394A86	hot carrier
CR232	48-83654H01	silicon
		mixer:
E201	1-80377A98	assembly, double balanced mixer
		filter:
FL201, 202	91-80377A94	ceramic, 10.7 MHz
		connector, receptacle:
J200	—	consists of:
	9-05416H01	PIN, receptacle; 18 used
J203, 204	9-5856A01	female; single contact
J205	9-84135B02	female, phono
J206	9-5856A01	female, single contact
		relay:
K201 thru 204	80-80377A59	spst, coil res 350 ohms; 5 V
		coil, rf:
L201 thru 207	24-83961B01	3 turns
L210	24-83961B01	3 turns
L211	24-80369A28	choke; 6.8 uH
L212	24-82549D28	10 uH
L213	24-80369A44	choke, 4700 uH
L214	24-83961B01	3 turns
L215, 216	24-80369A44	choke; 4700 uH
L217, 218	24-82549D41	choke; 100 uH
L219	24-80369A21	choke; 0.68 uH
L220	24-83961B01	3 turns
L221	24-80369A22	choke; 1 uH
L222	24-80369A32	choke; 2.2 uH
L223	24-83961B01	3 turns
L224	76-83960B01	choke, bead; 3 turns
L225	24-80348B09	toroidal transformer
		transistor: (see note)
Q201	48-869571	PNP, type M9571
Q202 thru 205	48-869570	NPN, type M9570
Q206	48-869649	PNP, M9649
Q207	48-869570	NPN; type M9570
Q213	48-869791	MOS field-effect
Q214	48-869878	N-channel FET; type M9878
		resistor, fixed; ± 5%; 1/4 W: unless otherwise stated
R201	6-124A01	10
R202	6-124A55	1.8k
R203	6-124A03	12
R204	6-124A25	100
R205	6-124A73	10k
R206	6-124A39	390
R207, 208	6-124A97	100k
R209	6-124A73	10k
R210	6-124A43	560
R211	6-124B02	150k
R212	6-124A61	3.3k
R213	6-185A35	270; 1/8 W
R214	6-124B22	1 meg
R215	6-124A72	9.1k
R216, 217	6-124B06	220k
R218	6-124A89	47k
R219	6-124A97	100k
R220	6-10621C67	5.6k ± 1%; 1/8 W
R221	6-10621C81	10k ± 1%; 1/8 W
R222	6-124A25	100
R223	6-124A09	22
R224, 225	6-124A49	1k
R226	6-124A67	5.6k
R227	6-124A97	100k
R228	6-124A73	10k
R229	6-185A41	470; 1/8 W
R230	6-185A18	51; 1/8 W
R231	6-124A09	22
R232, 233	6-124B67	8.2
R234	6-10621C87	9.09k ± 1%; 1/8 W
R235	6-124A49	1k
R236, 237	6-124A57	2.2k
R238	6-124A73	10k
R239	6-124A57	2.2k
R240	6-124A73	10k
R241	6-124A29	150
R242	6-185A57	2.2k; 1/8 W
R243, 244		NOT USED
R245	6-185A57	2.2k; 1/8 W
R246	6-124A73	10k
R247	6-125A48	1k; 1/2 W
R248	6-11024A13	33; 1/8 W (chip)
R249	6-185A18	51; 1/8 W
R250	6-10621E53	464k ± 1%; 1/8 W
R251	6-10621D49	39.2k ± 1%; 1/8 W
R252	18-83452F18	variable; 20k
R253	6-124A97	100k
R254, 255		NOT USED
R256	6-185A80	20k; 1/8 W
R258	6-124A91	560
R259		NOT USED
R260	6-124A85	33k
R261	6-185A25	100; 1/8 W
R262, 263	6-124A65	4.7k
R264		NOT USED
R265	6-124A25	100
R266	6-124A67	5.6k
R267		NOT USED
R268	6-124A89	47k
R269	6-124B16	560k
R270, 271		NOT USED
R273	6-10621B78	681 ± 1%; 1/8 W
R273	6-10621C83	5.11k ± 1%; 1/8 W
R274	6-124A45	680
R275	6-124A65	4.7k
R276	18-83452F10	variable; 1k
R277	6-185A07	18; 1/8 W
R278, 279	6-185A35	270; 1/8 W
R280	6-124A37	330
R281	6-124A73	10k
R282	6-124A97	100k
R283	6-10621D33	28.7k ± 1%; 1/8 W
R284	6-185A89	8.8k; 1/8 W
R285		NOT USED
R286	6-11009C61	3.3k
R287	6-11009C58	2.4k
		integrated circuit: (see note)
U201, 202, 203	51-80345A34	rf amplifier
U204, 205	51-80345A35	rf amplifier
U206	51-80365A07	dual operational amplifier
U207	51-80365A08	operational amplifier
U208	51-82894L48	quad analog switch
U209	51-83629M08	quad operational amplifier
U210	51-83629M07	operational amplifier

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		voltage regulator: (see note)
VR201	48-80378A48	Zener type; 4.3 V
VR202	48-82256C23	Zener type; 6.8 V
VR203, 204	48-83624E52	Zener type; 3.3 V
VR205	48-82256C23	Zener type; 6.8 V
	mechanical parts	
	26-80378A92	SHIELD
	26-80348B64	SHIELD, rf

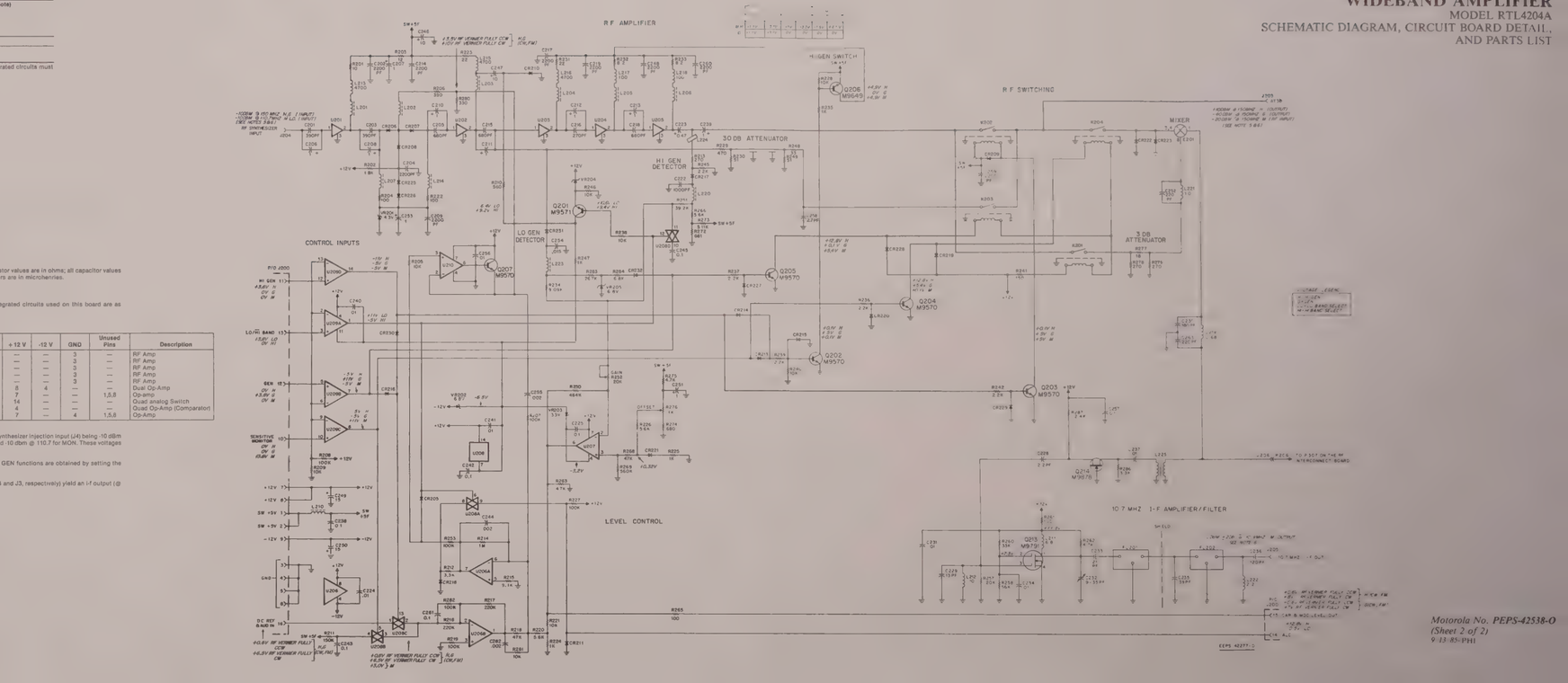
note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

NOTES:

1. Unless otherwise indicated, all resistor values are in ohms; all capacitor values are in microfarads and all inductors are in microhenries.
2. IC types are TTL & CMOS devices.
3. Types and connections for the integrated circuits used on this board are as follows:

Reference Designation	+5 V	+12 V	-12 V	GND	Unused Pins	Description
U201	Filt. +5 V; 2	—	—	3	—	RF Amp
U202	Filt. +5 V; 2	—	—	3	—	RF Amp
U203	Filt. SW +5 V; 2	—	—	3	—	RF Amp
U204	Filt. SW +5 V; 2	—	—	3	—	RF Amp
U205	Filt. SW +5 V; 2	—	—	3	—	RF Amp
U206	—	8	—	—	—	Dual Op-Amp
U207	—	7	—	—	1,5,8	Op-amp
U208	—	14	—	—	—	Quad analog Switch
U209	—	4	—	—	—	Quad Op-Amp (Comparator)
U210	—	7	—	4	1,5,8	Op-Amp

4. All dc voltages obtained with an rf synthesizer injection input (J4) being -10 dBm @ 150 MHz for HI GEN and GEN, and -10 dbm @ 110.7 for MON. These voltages are typical values.
5. RF output levels in the AI GEN and GEN functions are obtained by setting the RF VERNIER control.
6. LO injection input and rf input (@J4 and J3, respectively) yield an i-f output (@ J9) as shown in the MON junction.



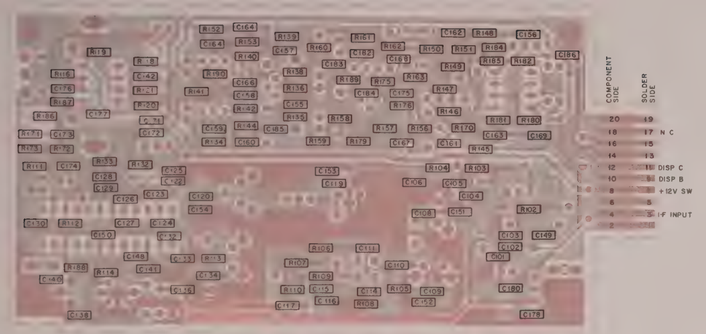
WIDEBAND AMPLIFIER

MODEL RTL4204A

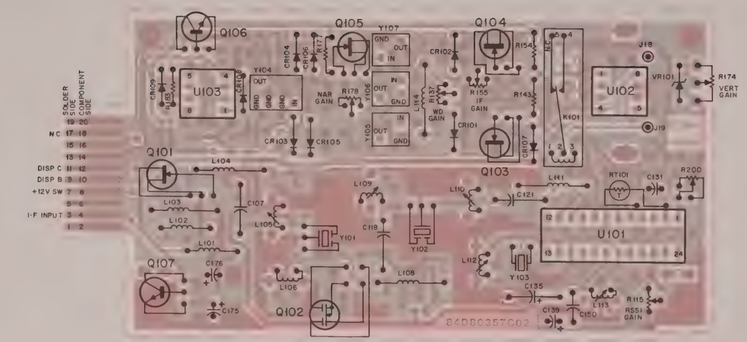
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

I-F BOARD

MODEL RTL4205A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



COMPONENT SIDE — BD-CEPS-42401-0(REVERSED)
SOLDER SIDE — BD-CEPS-42402-0(REVERSED) SHOWN FROM SOLDER SIDE
OL-CEPS-42464-0



COMPONENT SIDE — BD-CEPS-42401-0
SOLDER SIDE — BD-CEPS-42402-0 SHOWN FROM COMPONENT SIDE
OL-CEPS-42403-0

parts list

RTL4205A I-F Board PL-9638-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: chip, ±F ±10%; 50 V: unless otherwise stated
C101	21-11032A09	.001 + 80-20%
C102	21-11031A25	2.2 pF ±0.25 pF
C103	21-11031A25	27 pF ±5%
C104	21-11031B10	5.6 pF ±0.5 pF
C105	21-11032A09	.001 + 80-20%
C106	21-11032B13	0.1 + 80-20%
C107	21-82405B46	0.82 ±5%, 500 V (non-chip)
C108, 109	21-11031A07	3.3 pF ±.25 pF
C110	21-11031A08	3.9 pF ±.25 pF
C111	21-11032A09	.001 + 80-20%
C114	21-11032A09	.001 + 80-20%
C115	21-11031B10	5.6 pF ±0.25 pF
C116	21-11032A09	.001 + 80-20%
C117	21-11032B13	0.1 + 80-20%
C118	21-82505B48	0.75 pF ±5%, 500 V (non-chip)
C119, 120	21-11031A07	3.3 pF ±.25 pF
C121	21-83405B47	1 pF ±5%, 500 V (non-chip)
C122	21-11031B08	3.9 pF ±.25 pF
C123	21-11032A09	.001 + 80-20%
C124, 125	21-11032B13	0.1 + 80-20%
C126	21-11032A09	.001 + 80-20%
C127, 128	21-11032B13	0.1 + 80-20%
C129, 130	21-11032A09	.001 + 80-20%
C131	23-82783B14	1.0 ±10%, 15 V (non-chip)
C132	21-11031A13	8.2 pF ±0.5 pF
C133	21-11031A15	10 pF ±0.5 pF
C134	21-11032A09	.001 + 80-20%
C135	23-84762H08	3.9 ±10%, 15 V (non-chip)
C136	21-11032A09	.001 + 80-20%
C138	21-11032A09	.001 + 80-20%
C139	23-82783B14	1.0 ±10%, 15 v (non-chip)
C140	21-11031A61	.001
C141, 142	21-11032B13	0.1 + 80-20%
C148	21-11032B13	0.1 + 80-20%
C149	21-11032A09	.001 + 80-20%
C150	21-82610C58	100 pF, 100 V (non-chip)
C151 thru 154	21-11031A07	3.3 pF ±0.25 pF
C155 thru 169	21-11032B13	0.1 + 80-20%
C171 thru 174	21-11032B13	0.1 + 80-20%
C175, 176	23-84685F01	10 + 100-10%; 25 V (non-chip)
C177	21-11031A39	100 pF
C178, 179, 180	21-11032B13	0.1 + 80-20%
C181	21-11031A50	300 pF
C182, 183, 184	21-11032B13	0.1 + 80-20%
C185	21-11031A51	330 pF
C186	21-11032B13	0.1 + 80-20%
		diode: (see note)
CR101 thru 106	48-83510F03	silicon
CR107, 108, 109	48-83654H01	silicon
		connector, receptacle:
J1B, 19	9-82615F01	female, phono
		relay:
K101	80-82617M11	12 V
		coil, rf:
L101	24-82723H33	14 uH
L102	24-82723H46	200 nH
L103	24-82723H37	6.2 uH
L104	24-82835C20	1.3 uH
L105, 106	24-05444F11	2 uH, 22-1/4 turns (coded ORG)
L108	24-82835Q30	1.3 uH
L109, 110	24-05444F11	2 uH; 22-1/4 turns (coded ORG)
L111	24-82835Q30	1.3 uH
L112	24-05444F09	1.5 uH, 17-3/4 turns (coded BLK)
L113	24-83522N01	1 uH
L114	24-82549D07	100 uH
		transistor: (see note)
Q101	48-869539	J-field-effect, type M9839
Q102	48-869687	MOS Field-effect, type M9687
Q103, 104, 105	48-869878	N-channel FET, type M9878
Q106	48-869570	NPN; type M9570
Q107	51-84821K73	8 V regulator
		resistor, fixed; chip, ±5%; 1/8 W: unless otherwise specified
R101	6-11024A11	27
R102	6-11024A31	180
R103	6-11024A87	5.6k
R104	6-11024A11	27
R105, 106	6-11024A69	6.8k
R107	6-11024A64	4.3k
R108	6-11024A21	68
R109	6-11024A71	8.2k
R110	6-11024A11	27
R111	6-11024A79	18k
R112	6-11024A99	120k
R113	6-11024A41	470
R114	6-11024A77	15k
R115	18-83452F14	var 10k ±10%; 1/2 W (non-chip)
R116	6-11024A73	10k
R118	6-11024A94	75k
R119	6-11024B14	470k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R120	6-11024B10	330k
R121	6-11024A99	120k
R132, 133	6-11024A77	15k
R134, 135	6-11024A64	4.3k
R136	6-11024A57	2.2k
R137	18-5501C11	var. 25k (non-chip)
R138	6-11024A57	2.2k
R139, 140	6-11024A64	4.3k
R141	6-11024A68	6.2k
R142	6-11024A56	2k
R143	6-11041A72	2k (non-chip)
R144	6-11024A57	2.2k
R145	6-11024A69	6.8k
R146	6-11024A55	1.8k
R147, 148	6-11024A52	2.7k
R149	6-11024A55	1.8k
R150	6-11024A68	6.8k
R151	6-11024A64	4.3k
R152	6-11024A71	8.2k
R153	6-11024A59	2.7k
R154	6-11041A69	1.5k (non-chip)
R155	18-5501C02	var 5k (non-chip)
R156	6-11024A64	4.3k
R157	6-11024A68	6.2k
R158	6-11024A29	150
R159	6-11024A68	6.2k
R160	6-11024A55	1.8k
R161	6-11024A41	470
R162	6-11024A55	1.8k
R163	6-11024A64	4.3k
R170	6-11024A64	4.3k
R171	6-11024A76	13k
R172	6-11024A38	360
R173	6-11024A76	13k
R174	18-83452F09	var. 1k ± 10%; 1/2 W (non-chip)
R175	6-11024A71	8.2k
R176	6-11024A58	2.7k
R177	6-11041A72	2k (non-chip)
R178	18-5501C02	var 5k (non-chip)
R179	6-11024A56	2k
R180	6-11024A84	30k
R181	6-11024A64	4.3k
R182	6-11024A60	3k
R183	6-11041A65	1k (non-chip)
R184	6-11024A41	470
R185	6-11024A90	51k
R186, 187	6-11024A73	10k
R188	6-11024A67	5.6k
R189, 190	6-11024R23	0 ohms
R200	18-5501C11	var 25k (non-chip)
RT101	6-867628	**thermistor:** 195k ohms @ 25° C
U101	51-83677M44	**integrated circuit: (see note)** custom
U102	51-82848M17	dual operational amplifier
U103	51-82609M33	dual high-frequency operational amplifier
VR101	48-82256C03	**voltage regulator: (see note)** Zener, 4.7 V
Y101, 102	91-83551N01	**crystal: (see note)** 45.0 MHz
Y103	48-82559K10	44.545 MHz
Y104	91-80348B15	15 kHz
Y105, 106, 107	91-80348B16	9 kHz

non-referenced items

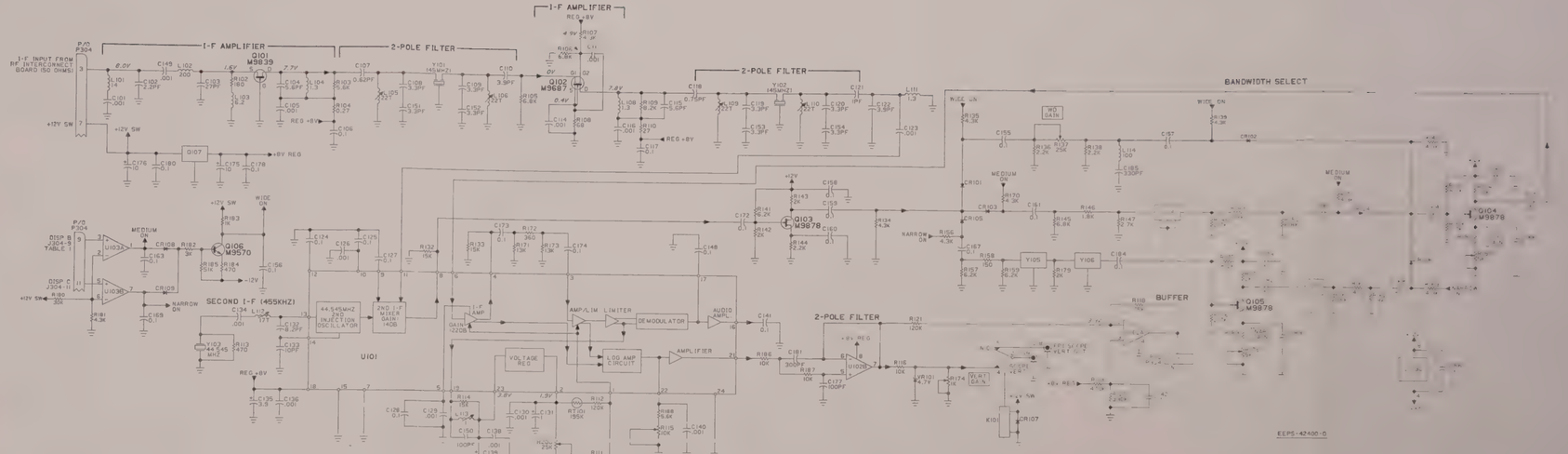
	3-139013	SCREW, lock 4-40 x 3/16", 8 used
	14-80348837	INSULATOR, board
	7-80348B02	BRACKET, phono connector
	9-80269B08	SOCKET, IC, 8-contact
	9-84306E02	SOCKET, IC, 16-contact
	14-84602K01	INSULATOR, crystal; 3 used
	26-82671D31	SHIELD, coil, 3 used
	26-80348B04	SHIELD, solder side cover
	26-80348B05	SHIELD, component side cover

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers

I-F BOARD

MODEL RTL4205A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



NOTES:

1. Unless otherwise specified, all resistor values are in ohms, capacitor values in microfarads, and inductor values in microhenries.

Table 1. Filter Switching

Disp B	Disp C	Bandwidth
0V	0V	WIDE
0V	5V	NARROW
5V	0V	MEDIUM
5V	5V	X

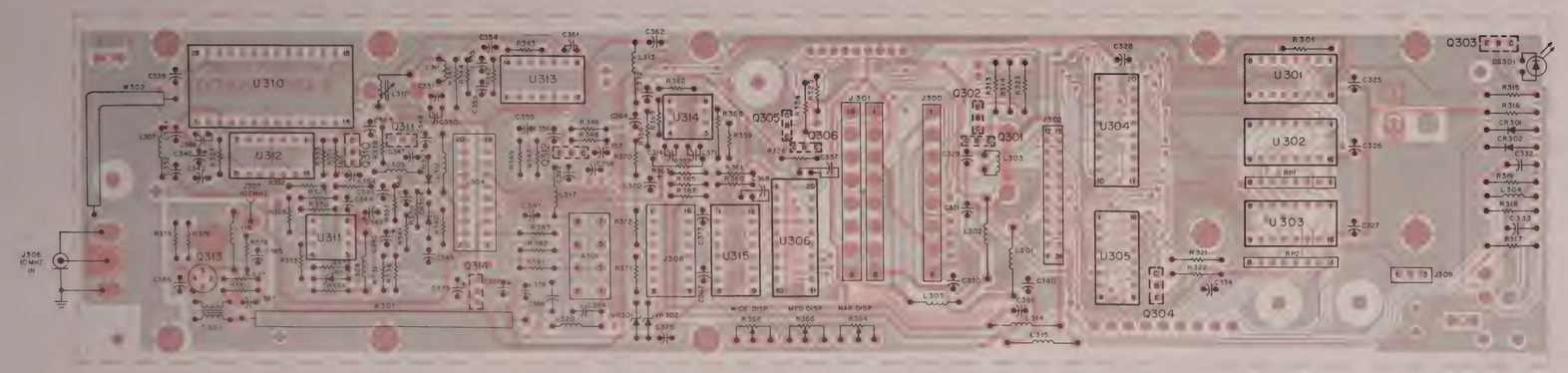
Table 2. Integrated Circuits Types and Connections

Reference Designation	+8 V REG	+12 V	-12 V	GND	Unused Pins	Description
U101	16	—	—	7, 15, 24	20	Custom IC
U102	8	—	—	4	—	Op Amp
U103	—	8	4	—	—	Op Amp

RF INTERCONNECT BOARD

MODEL RTL4202A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



COMPONENT SIDE 80-0EPS-42405-0

SOLDER SIDE 80-0EPS-42406-0 SHOWN FROM COMPONENT SIDE

OL-0EPS-42407-0

J300 DETAIL

1	-12V
2	+12V
3	WATTMETER ENABLE
4	TEMP
5	PROTECT
6	POWER METER
7	GND
8	ANTENNA ENABLE

J301 DETAIL

AM MOD AUDIO	16	1	SW +5V
CAR & MOD LEVEL OUT	15	2	SW +5V
ALC	14	3	GND
LO/HI BAND	13	4	GND
GEN	12	5	GND
HI GEN	11	6	GND
SENS MOD	10	7	+12 V
-12V	9	8	+12 V

J302 DETAIL

+5V	12	13	GND
A3	11	14	ALC
A2	10	15	LO/HI BAND
STROBE 1	9	16	CAR & MOD LEVEL OUT
A0	8	17	POWER METER
A1	7	18	DC REF & AUD IN (AM)
D4	6	19	P.O.R.
D3	5	20	D5
D2	4	21	D6
D1	3	22	STROBE 3
D0	2	23	-12 V
D7	1	24	+12V

J304 DETAIL

GND	20	19	+5VF
GND	18	17	N.C.
GND	16	15	+12V
GND	14	13	-12VF
GND	12	11	DISP 'C'
GND	10	9	DISP 'B'
GND	8	7	+12V SW
GND	6	5	+8V
GND	4	3	I-F OUTPUT
GND	2	1	N.C.

J308 DETAIL

RAMP IN	1	16	N.C.
N.C.	2	15	N.C.
N.C.	3	14	N.C.
N.C.	4	13	N.C.
N.C.	5	12	N.C.
N.C.	6	11	N.C.
N.C.	7	10	N.C.
-5V	8	9	N.C.

J309 DETAIL

1	S.A. ON	
2	N.C.	
3	GND	

Motorola No. PEPS-42540-O
(Sheet 1 of 2)
9/13/85 PHI

parts list

RTL4202A RF Interconnect Board
1-80352A99 Wired Switch Assembly
1-80377A74 Attenuator Potentiometer Assembly
1-80305A71 RF Module Feed-thru Assembly PL 9831-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
A301	1-80377A98	**assembly:** mixer
AT3	1-80377A74	**attenuator, potentiometer:** 0-70 ohms
C1 thru 24	21-84874K01	**capacitor, fixed: uF ± 10%; 50 V:** feed-thru, 470 pF ± 20%; 250 V
C325 thru 331	21-84008H01	.01
C332, 333	21-82428A47	.002 ± 5%, 200 V
C334	21-84008H01	.01
C337	21-84008H01	.01
C339	21-84008H28	0.1 ± 20%
C340	23-84665F01	10 + 100-10%; 25 V
C341, 342	21-84008H28	0.1 ± 20%
C343	23-84665F01	10 + 100-10%; 25 V
C344	21-84008H01	.01
C345	23-80390A78	10 ± 20; 25 V
C346	21-84008H23	0.1 ± 20%
C347	23-5311E29	22 pF ± 5%; 25 V
C348, 349	21-5668G01	220 pF ± 5%
C350	21-84008H28	0.1 ± 20%
C351	21-84008H01	.01
C352	21-84008H28	0.1 ± 20%
C353	21-5453G25	2.2 pF ± 0.25 pF; 63 V
C354, 355	21-84008H01	.01
C356	21-5457G09	.001; 63 V
C357, 358	21-84008H01	.01
C359	21-80397A12	820 pF ± 5%; 100 V
C360	21-84008H28	0.1 ± 20%
C361	21-5457G09	.001; 63 V
C362	21-84008H01	.01
C363	21-80397A12	820 pF ± 5%; 100 V
C364 thru 368	21-84008H01	.01
C370	23-84665F01	10 + 100-10%; 25 V
C371	21-84008H01	.01
C373	21-5668G01	220 pF ± 5%
C374	21-84008H01	.01
C375	21-84008H28	0.1 ± 20%
C377	23-84665F01	10 + 100-10%; 25 V
C378	21-84008H01	.01
C379	23-83441B15	1.0 ± 20%, 35 V
C380, 381	21-84008H01	.01
C385 thru 387	21-84008H01	.01
C388, 389	21-82187B04	270 pF; 500 V
C391, 392	21-5453G40	39 pF ± 5%; 63 V
CR301, 302	48-8365H01	**diode: (see note)** silicon
CR303, 304	48-80397A25	varactor
DS301	48-80159E09	**light emitting diode: (see note)** red
J300	—	**connector, receptacle:** consists of:
J301	9-05418H01	PIN, receptacle; 8 used
	—	consists of:
	9-05418H01	PIN, receptacle; 16 used
J302	9-80312B37	female, 24-contact
J304	9-80346B96	female, 20-contact
J306	9-5261F01	female, phono
J307	9-05866A01	female, single contact
J308	9-84006E02	female, 16-contact
J309	28-80346B58	male, 3-contact
L301	24-8254R07	**coil, rf:** 56 uH
L302	24-80346A83	470 uH
L303	25-80127G01	1.5 mH
L304	24-80369A25	0.22 uH
L305	24-80369A23	0.15 uH
L306	—	NOT USED
L307	24-80369A21	680 nH
L308	24-8254R41	100 uH, coded ORG
L309	24-83961B01	3-turns, coded BRN
L310	24-82556N02	variable; 382 nH
L311	24-11030D04	coded GRN
L312	24-8254R41	100 uH, coded ORG
L313	24-8254R37	100 uH
L314, 315	24-8254R41	100 uH, coded ORG
L316	—	NOT USED
L317	24-80369A25	220 nH
L318	—	NOT USED
L319	24-80369A22	1 uH
L320	24-80369A21	680 nH
Q301	48-869549	**transistor: (see note)** PNP; type M9649
Q302	48-869571	PNP; type M9571
Q303	48-869570	NPN; type M9570
Q304	48-869571	PNP; type M9571
Q305	48-969706	Darlington, NPN type M9706
Q306	48-869649	PNP; type M9649
Q307 thru 309	—	NOT USED
Q310	48-869932	NPN; type M9932
Q311	48-869878	N-channel FET; type M9878
Q312	48-869932	NPN; type M9932
Q313	48-869791	dual MOSFET; type M9791
Q314	51-84621K73	8-volt regulator
R301	6-11009C81	**resistor, fixed: ± 5%; 1/8 W** unless otherwise stated 22k, 1/4 W
R302 thru 312	—	NOT USED
R313	6-11009C73	10k, 1/4 W
R314, 315	6-11009C65	4.7k, 1/4 W
R31	6-11009C41	470, 1/4 W
R317	6-11009C73	10k, 1/4 W
R318	6-11009C49	1k, 1/4 W
R319	6-11009C47	820, 1/4 W
R320	18-80390A75	var 10k
R321, 322	6-11009C49	1k, 1/4 W
R323	6-11009C29	150; 1/4 W
R324	6-11041C41	[illegible]
R325	6-11041C81	4.7k
R326, 327	6-11041C89	10k
R328	6-11041C91	12k
R329	6-11041C97	22k
R330	6-11041D24	270k
R331	6-11041D10	68k
R332, 333	6-11041C95	18k
R334	6-11041C85	6.8k
R335	—	NOT USED
R336	6-185B07	240k
R337	6-11041C89	10k
R338	6-11041C41	100
R339, 340	6-11041C95	18k
R341	6-11041D14	100k
R342	6-11041C81	4.7k
R343, 344	6-11041C91	12k
R345	6-11009C01	10, 1/4 W
R346	6-11041C88	9.1k
R347	6-11041C71	1.8k
R348	6-11041C41	100
R349	6-11041C37	68
R350	—	NOT USED
R351	6-11041C88	9.1k
R352	6-11041C71	1.8k
R353	6-11009C45	680, 1/4 W
R354	6-11041C33	47
R355	—	NOT USED
R356	6-11041D14	100k
R357, 358	8-84640C81	22.1k
R359	6-11041C85	6.8k
R360	6-11041C95	18k
R361	6-11041D14	100k
R362	6-11041D10	68k
R363	6-11041C65	1k
R364	18-83452F13	var 10k ± 10%, 1/2 W
R365	6-11041D02	33k
R366	18-83452F23	var. 50k ± 10%, 1/2 W
R367	6-11041D14	100k
R368	18-83452F23	var 500k ± 10%, 1/2 W
R369	6-11041C89	10k
R370	6-11041C73	2.2k
R371	6-11009C65	4.7k, 1/4 W
R372	6-11041C95	18k
R376	6-11041C89	10k
R377	6-11041D02	33k
R378	6-11041D07	51k
R379, 380	43-80346B18	47
R381	6-11041C25	22
R382	6-11041C33	47
R383	6-11041C25	22
RP1, 2	51-82759N09	**resistor pack:** 2.2k ohms
S1	1-80352A99	**switch:** assembly includes
	40-80378A28	SWITCH, rotary 8-position
T301	24-80348B10	**transformer, coupling:** ferrite bead core
U301	51-84561L52	**integrated circuit: (see note)** decoder/demultiplexer
U302, 303	51-84561L77	hex 3 state buffer
U304	51-82609M17	hex 'D' type Flip-Flop
U305	51-82848M48	PROM
U306	51-82609M17	hex 'D' type Flip-Flop
U310	51-80345B45	phase lock loop
U311	51-80365A07	dual operational amplifier
U312	51-80345B84	dual 'D' type Flip-Flop
U313	51-80365A15	video amplifier
U314	51-80365A07	dual operational amplifier
U315	51-82884L65	3 to 2 channel multiplexer/demultiplexer
VR301	48-82256C15	**voltage regulator: (see note)** Zener, 5.1 V
VR302	48-82624E52	Zener, 3.3 V
VR303	48-82372L05	Zener, 3.9 V

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
W301	30-85377A92	**cable** semi-rigid coaxial
W302	30-80346B65	semi-rigid coaxial
	non-referenced items	
	1-80305A71	FEED-THRU PLATE, assembly; includes ref item C1 thru 24
	1-80352A99	SWITCH, wired, assembly; includes ref item S1
	26-80346B63	SHIELD
	4-821624	WASHER, insulated
	22-80348B17	PIN, feed-thru

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers

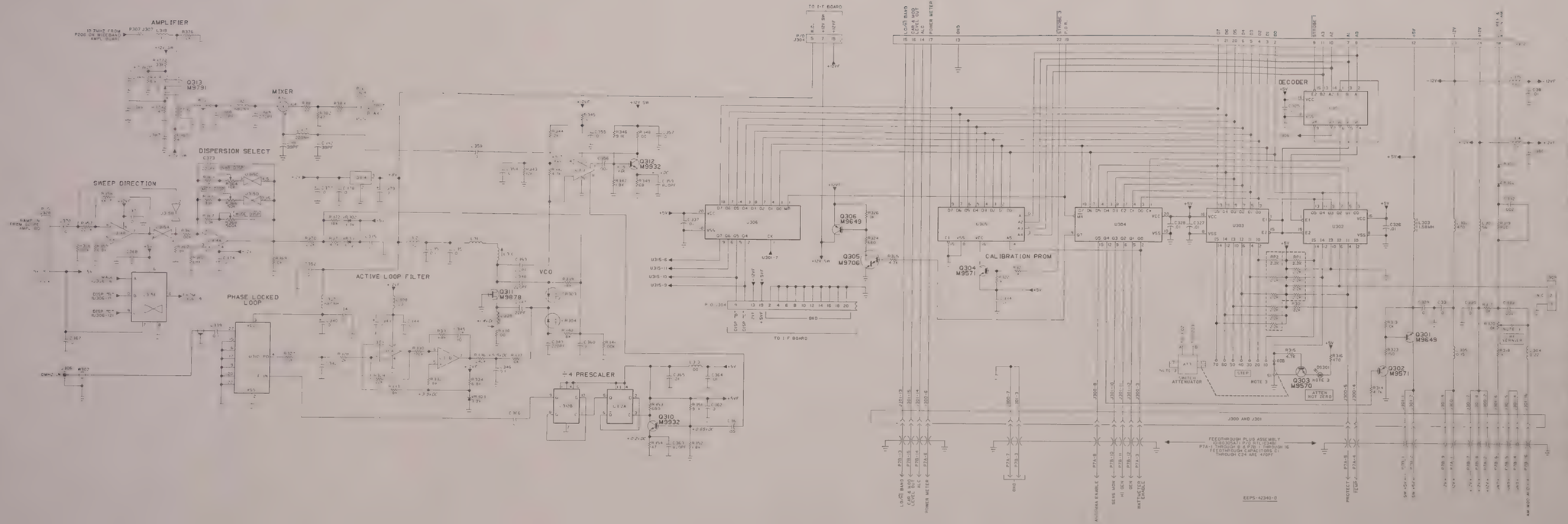
RTL1034A RF Module Miscellaneous Parts PL 9835-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
J1	9-82711A01	**connector, receptacle:** rf inhibit; female, single contact
J2, 3	9-80377A71	attenuator; female, SMB type, single contact
J4	9-80377A71	rf synthesizer input; female, SMB type, single contact
J6	9-80377A71	antenna; female, SMB type, single contact
	non-referenced items	
	1-80356A04	CABLE, coaxial (long hard line)
	1-80356A06	CABLE, coaxial (short hard line)
	2-7041	NUT, hex; 2-56 × 3/16", 2 used
	2-131435	NUT, hex; 4-40 × 1/4 × 3/32", 2 used
	3-2942	SCREW, machine; 4-40 × 3/16", 2 used
	3-129575	SCREW, lock; 4-40 × 1/4", 8 used
	3-136782	SCREW, machine; 2-56 × 3/16", 24 used
	3-136890	SCREW, machine; 4-40 × 9/32", 8 used
	3-138804	SCREW, machine; 4-40 × 5/16", 10 used
	3-139003	SCREW, machine; 4-40 × 3/8", 2 used
	3-139581	SCREW, machine; 4-40 × 5/16", 6 used
	3-139977	SCREW, machine; 4-40 × 5/16", 12 used
	3-80348982	SCREW, band head; 5 used
	4-8406	WASHER, locked; 16 used
	4-8434	WASHER, lock, internal #4; 2 used
	4-146206	WASHER, lock; medium split
	4-861570	WASHER, insulator; 2 used
	7-80312B18	BRACKET
	7-80312B20	BRACKET, mounting
	7-80377A33	BRACKET, attenuator
	7-80390A29	BRACKET, rf vernier control
	14-80395A02	INSULATOR
	14-80395A03	INSULATOR
	15-80312B49	COVER
	15-80312B55	COVER
	26-80346B03	SHIELD
	29-5318	LUG, solder
	42-80313A70	TIE, wrap; 2 used
	42-8295A06	CLIP
	43-80312B93	SPACER; 2 used
	43-80346B18	STAND-OFF; 4 used
	55-84300B02	HANDLE

RF INTERCONNECT BOARD

MODEL RTL4202A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



NOTES:

1. Unless otherwise indicated, all resistor values are in ohms, capacitor values are in microfarads, and inductor values are in microhenries.
2. IC types are TTL & CMOS devices.
3. Part mounted on board, but extends thru front panel when module is installed.
4. Types and connections for the integrated circuits used on this board are as follows:

Reference Designation	Mfgr's. Description	+5 V	-5 V	+12 V	-12 V	+8 V	Gnd	Unused Pins
U301	Dec Up/Down	16	–	–	–	–	8	7,10,11,12
U302	Hex 3-State Buffer	16	–	–	–	–	8	7,9
U303	Hex 3-State Buffer	16	–	–	–	–	8	–
U304	Octal D Flip-Flop	20	–	–	–	–	10	16
U305	PROM	16	–	–	–	–	8	–
U306	Octal D Flip-Flop	20	–	–	–	–	10	2,5,8,9
U310	Phase Locked Loop	–	–	–	–	1	2	5,14,16,21,23,26,28
U311	Quad Op Amp	–	–	8	–	–	4	–
U312	Dual D Type Flip-Flop	14	–	–	–	–	7	–
U313	Video Amp	–	–	10	–	–	5	7,4,6,8,11,13
U314	Quad Op Amp	–	–	8	–	–	4	–
U315	3 to 8 Chan. Multiplexer Demultiplex	16	7	–	–	–	8	–

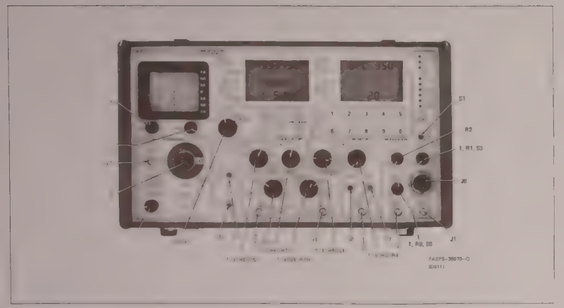
Truth Table-RTL4202A

	Address				Data										
Mode	Module Write A6	Module Enable A1	A1 & A2	A3	Strobe S5	S1	S2	S3	D0	D1	D1 & D3	D3	D4	D5	D6	D7
HI GEN	0	–	1	1	X	–	X	1	0	0	0	1	0	0	0	1
GEN	0	–	1	1	X	–	X	1	0	0	0	0	0	0	0	0
PWR MON	0	1	1	1	X	–	X	1	0	0	0	1	0	0	1	0
SENS MON	0	1	1	1	X	–	X	1	0	0	0	1	0	0	1	1
S A PWR MON	0	1	1	1	X	–	X	1	0	0	0	1	0	0	1	0
S A SENS MON	0	1	1	1	X	–	X	1	0	0	0	1	0	0	1	1
Spectrum Analyzer Control																
WIDE DISP	1	1	1	1	X	–	X	1	X	X	X	X	0	0	X	X
MED DSP	1	1	1	1	X	–	X	1	X	X	X	X	0	1	X	X
NAR DISP	1	1	1	1	X	–	X	1	X	X	X	X	1	0	X	X
HI INJ	1	1	1	1	X	–	X	1	X	X	X	X	1	1	0	X
LO INJ	1	1	1	1	X	–	X	1	X	X	X	X	X	X	0	X
SWP ON	1	1	1	1	X	–	X	1	X	X	X	X	X	X	1	0
SWP OFF	1	1	1	1	X	–	X	1	X	X	X	X	X	X	X	1
	Module Read	Module Enable														
TEMP PROTECT S A	0	0	1	1	X	0	X	1								
ATTENTUATOR	0	1	1	1	X	0	X	1								

* Indicates positive edge trigger

CHASSIS MECHANICAL LESS REAR PANEL AND MAIN INTERCONNECT BOARD

MODEL RTX1012A
PARTS LIST



Motorola No. PEPS-42541-O
9/13/85 PHI

parts list

RTX1012A Basic Chassis
RTX1008B Basic Chassis

PL-8500-B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		motor:
B1	59-80378A94	fan
		capacitor, fixed:
C1 thru 7	21-83599E13	.001 uF ± 10%; 500 V
		light emitting diode: (see note)
DS1	48-05776C01	red
		coil:
E1 thru 7	76-83960S01	ferrite, core
E8	76-80397A74	ferrite bead
E9, 10, 11	76-80312A75	ferrite bead
		fuse:
F1	65-42092	2 amp; 250 V
F2	65-80397A22	8 amp; 32 V
F3	65-20404	3 amp; 250 V
F4	65-474899	1/8 amp; 250 V
		filter:
FL1	91-80390A52	line
		connector, receptacle:
J1 thru 5	9-855268	female; single contact (BNC)
J6	9-830416	female; 4-contact
J6	15-10811A07	housing, plug; 4-contact
J7	9-80378A51	female; single contact (BNC)
		coil, rf:
L1 thru 7	24-82549D41	choke; 100 mH
		connector, plug:
P1	15-80312B03	housing, 30-contact; 2 used
P2	15-80390A10	housing, 9-contact
P3	28-80390A05	male, 3-contact A.C.
		resistor:
R1	18-80378A30	variable: 5k; includes S3
R2	18-80378A29	variable; 5k
R3, 4	18-80378A21	variable; 100k
R5		part of S4
R6, 7	18-80378A22	variable; 2k
R8		part of S5
R9	18-80378A30	variable: 5k; includes S6
R10		part of S8
R12	8-11009C85	4.7k ±5%; 1/4 W (RTX1012A)
		varistor:
R11	8-80395A72	1200 amp, 430 V @25°C
		switch:
S1	40-80378A10	spst, toggle
S2	40-80378A27	rotary, 5 position (RTX1008B)
	or 40-80348B11	rotary: 4-pole; 8 position (RTX1012A)
S3		part of R1
S4	40-80312B41	1 pole, 4 position
S5	40-80378A27	rotary: 1 pole; 5 position
S6		part of R9
S7, 8	40-80378A34	spdt
S9	40-80397A30	1 pole, 3 position
S10	40-80397A33	rotary: 1 pole, 3 position
S11	40-80378A25	single pole triple throw
S12	40-80385A84	dpdt
S13	40-80390A50	rocker
		transformer:
T3	25-80312B60	line
		mechanical parts
1 (note 2)	36-80337A83	KNOB, 8 used (RTX1008B), 7 used (RTX1012A)
2	36-80397A83	KNOB
3 (note 2)	36-80337A88	KNOB, 4 used (RTX1008B), 3 used (RTX1012A)
4	36-80337A89	KNOB (BLK and BLU)
5	36-80337A85	KNOB (BLK); 2 used
	2-80348B37	NUT
	3-80348B42	SCREW, set
	4-80348B78	WASHER
	2-115123	NUT, 10-32 × 3/8 × 1/8"; 2 used
	2-131435	NUT, 4-40 × 1/4 × 3/32"; 3 used
	3-136782	SCREW, machine: 2-56 × 3/16"; 2 used
	3-138804	SCREW, machine 4-40 × 5/16", 36 used
	3-138929	SCREW, machine 4-40 × 5/8", 14 used
	3-139579	SCREW, machine 4-40 × 5/16", 14 used
	3-140207	SCREW, machine: 4-40 × 5/16", 8 used
	3-80335A97	SCREW, machine: BLK, 6-32 × 0.312"; 7 used
	43-80312B10	SPACER BEAM; 2 used
	43-80397A41	STANDOFF, hex 1/4"; 8 used
	4-8406	LOCKWASHER, #2 internal; 2 used
	4-140206	LOCKWASHER, #4 split, 8 used
	4-140208	LOCKWASHER, #6 split, 7 used
	7-80390A17	BRACKET, card guide; 2 used
	2-84201D82	NUT, 2 used
	3-139013	SCREW, machine, 4-40 × 3/16; Phillips; 6 used

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	4-8434	LOCKWASHER: #4 int.; 4 used
	26-80312B13	SHIELD; 4 used
	26-80397A70	SHIELD
	26-80397A78	SHIELD
	1-80352A89	ASSEMBLY, cable: w/connector; includes R309 (RTX1012A)
	1-80352A88	CABLE, coaxial; 9.25" (RTX1012A)
	1-80352A87	CABLE, coaxial; 12" (RTX1012A)
	26-80397A67	SHIELD
	26-80397A69	SHIELD
	42-80213A70	STRAP, tie: 4" long
	46-80377A49	GUIDE, card; 2 used
	46-80395A24	GUIDE, card (ORG); 2 used
	46-80395A25	GUIDE, card (YEL); 2 used
	46-80395A26	GUIDE, card (BLU); 2 used
	46-80395A27	GUIDE, card (RED); 2 used
	46-80395A28	GUIDE, card (BRN); 2 used
	46-80395A29	GUIDE, card (GRN); 2 used
	46-80395A30	GUIDE, card (VIO); 2 used
	47-80377A11	BEAM, main
	47-80377A12	BEAM, main
	47-80377A13	BEAM, main
	47-80377A14	BEAM, main
	47-80377A15	BEAM, main
	47-80377A16	BEAM, main
	47-80377A17	BEAM, cross
	47-80377A18	BEAM, cross
	47-80377A19	BEAM, cross
	47-80377A20	BEAM, center
	47-80377A21	BEAM, support
	47-80378A63	BEAM, center
	54-80317B08	LABEL, identification
	55-80378A53	HANDLE
	15-80377A34	HOUSING, power supply
	6-80377A40	GUIDE, card; 2 used
	64-80312B73	PLATE, base
	1-80351A49	ASSEMBLY FRONT PANEL includes: refer J1 thru 5, R1, 2, 3, 4, 9, L1, 2, 3, S1, 2, 4, 9, 10, 11, 12, P1 (RTX1008B)
	or 1-80352A90	ASSEMBLY FRONT PANEL includes: refer J1 thru 5, R1, 2, 3, 4, 9, L1, 2, 3, S1, 2, 4, 9, 10, 11, 12, P1 (RTX1012A)
	1-80350A50	ASSEMBLY CABLE w/CONNECTOR Includes P1
	30-848407	CABLE, 2 conductor shielded; 10" used
	30-859004	CABLE, coaxial RG188/U
	39-80312B11	CONTACT, crimp; 54 used
	1-80350A39	ASSEMBLY FILTER BOARD includes: refer C4, 5, 6, 7 and L4, 5, 6, 7, 8, E4, 5, 6, 7
	4-7699	LOCKWASHER #13/16" internal
	4-115021	LOCKWASHER #1/4" internal; 8 used
	4-125904	LOCKWASHER: 0.375 × 0.625 × .030; 7 used
	4-80395A94	WASHER, dress; 3 used
	4-80397A42	WASHER, retainer
	7-80378A50	BRACKET, LED mounting
	13-80390A41	BEZEL; 2 used
	13-80390A42	BEZEL
	14-80312B01	INSULATOR, shield; 1/2 × 3/4
	25-80397A80	SHIELD, connector
	26-80397A65	SHIELD
	29-10261A05	LUG, soldering; 3 used
	30-83794C01	CABLE, coaxial, 6" used
	35-80390A46	SCREEN, scope w/graticule
	64-80312B59	PANEL, front (RTX1008B)
	or 64-80348B01	PANEL, front (RTX1012A)
	64-80377A51	PANEL, front
	1-80351A41	ASSEMBLY REAR PANEL includes B1, F1, F2, E8, E9, FL1, P1 P3, R11, and J6
	2-115123	NUT, 10-32 × 3/8 × 1/8"; 4 used
	2-131435	NUT, 4-40 × 1/4 × 3/32"; 10 used
	2-138818	NUT, 6-32 × 1/4 × 3/32 × 1/8"; 3 used
	3-138810	SCREW, machine: 4-40 × 5/8"
	3-490642	SCREW, machine: 10-32 × 1-1/2"; 4 used
	3-80312B02	SCREW, machine: 4-40 × 1-1/8"; 4 used
	3-80335A97	SCREW (BLK): 6-32 × 0.312; 3 used
	3-80395A09	SCREW, Phillips pan: 4-40 × 0.375, 14 used
	4-7807	WASHER, flat: 0.125 × 0.281 × .027
	4-140208	LOCKWASHER, #4 split; 15 used
	4-140209	LOCKWASHER, #6 split; 3 used
	9-80312B40	RECEPTACLE, fuse; 3 used
	9-82393U22	CONNECTOR
	13-80390A35	GRILLE
	14-80312B64	INSULATOR
	26-80312B63	SHIELD
	29-5348	LUG, soldering; 2 used
	39-80397A64	CONTACT, receptacle, 2 used
	30-80395A86	CABLE, 9 conductor
	38-80395A08	CAP, sealing connector
	43-80312B58	SPACER, BLK, 3 used
	39-10184A24	CONTACT, receptacle; 2 used
	39-10184A91	CONTACT, receptacle, 3 used

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	39-80395A83	TERMINAL, socket; 6 used
	39-80397A64	CONTACT; 2 used
	42-82143C01	CLAMP, cable
	43-80390A34	SPACER; 4 used
	64-80312B65	PANEL, back
	75-80378A91	FEET, rubber; 4 used
	54-80317B90	LABEL, identification
	1-80307A71	IC ASSEMBLY, interconnect
	15-80390A10	HOUSING, connector, 9-position
	29-80312B22	CONTACT, 2 used

notes:

1. For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.
2. On the RTX1012A Basic Chassis, one outer knob (Motorola Part No. 36-80348B76) replaces the 36-80337A83 knob associated with R6, R7, and one inner knob (Motorola Part No. 36-83573H09) replaces the 36-80337A86 knob associated with R6, R7.

RTL4125B Hardware Kit

PL-8979-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		battery:
BT1	60-83294N03	3 V, lithium
		non-referenced items
	3-138804	SCREW, machine: 4-40 × 5/16"; 13 used
	3-139561	SCREW, machine: 4-40 × 5/16"; 2 used
	3-140207	SCREW, machine: 4-40 × 5/16"; 21 used
	3-80335A97	SCREW, black, 6-32 × 0.312"; 3 used
	4-1714	WASHER, flat: 0.250 × 0.562 × .054
	4-7807	WASHER, flat: 0.125 × 0.281 × .027; 2 used
	4-13573P	WASHER, flat: 0.128 × 0.800 × .021
	4-140208	WASHER, lock #4 split; 21 used
	4-140209	WASHER, lock #6 split; 3 used
	4-80395A89	WASHER, nylon; 2 used
	2-8364	NUT, hex: 3/8-32 × 1/2 × 3/32"; 2 used
	2-80325A82	NUT, spring; 4 used
	3-120621	SCREW, machine: 4-40 × 1/4"; 8 used
	3-136888	SCREW, machine: 4-40 × 3/8"; 10 used
	3-80342A47	SCREW, machine: 8-32 × 1/4"; 4 used
	4-8434	WASHER, lock #4 internal; 8 used
	7-80390A16	BRACKET, clip
	15-80312B69	COVER, top
	26-80312B04	SHIELD
	26-80312B05	SHIELD
	26-80312B06	SHIELD; 3 used
	33-80348A05	NAMEPLATE
	30-80397A62	CORD, line AC
	32-80390A18	GASKET
	36-80337A83	KNOB; 3 used
	36-80397A63	KNOB
	41-80312B15	SPRING, compression
	41-80397A47	SPRING, 2 used
	41-80312B16	SPRING
	42-80313A70	TIE WRAP 4"
	54-80397A77	LABEL
	54-83581U01	LABEL, line cord
	55-80390A29	STRIKE; 2 used
	55-80395A05	HINGE, 2 used
	64-80377A28	BEZEL, casting

R2400A Service Monitor w/Spectrum Analyzer Miscellaneous Parts
R2200B Service Monitor Miscellaneous Parts

PL-8980-A

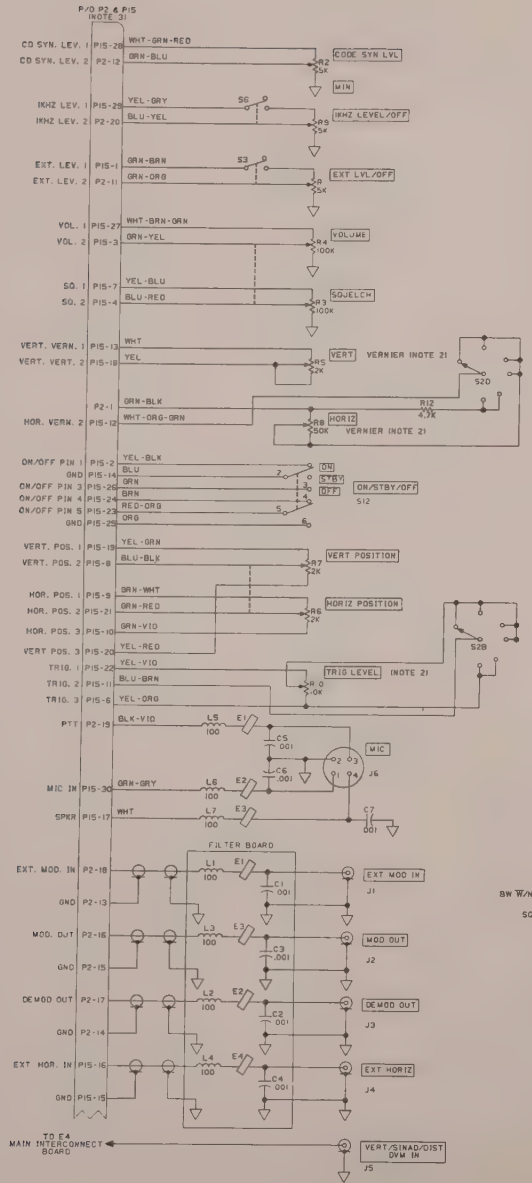
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector:
J1	28-82365D02	mate, single contact (phono)
		mechanical parts
	1-80356A05	CABLE, coaxial, flex
	1-80356A07	CABLE, semi-rigid
	1-80356A09	CABLE, semi-rigid
	1-80307A73	ASSEMBLY IC, interconnect; 2.5" includes J1 (R2200B)
	or 1-80307A75	ASSEMBLY IC, interconnect; 13" includes: J1, J2, J3(B (R2400A)
	30-83794C01	CABLE, coaxial; 20"
	1-80351A48	ASSEMBLY BOTTOM COVER, includes:
	4-114970	WASHER, flat: 0.125 × 0.250 × .020; 8 used
	4-7569	WASHER, flat
	14-80397A43	INSULATOR
	15-80312B70	COVER, bottom
	55-80334A52	BAIL, self-lock
	75-82566B01	BUMPER, rubber; 2 used
	1-80350A30	ASSEMBLY, CABLE & CONNECTOR, includes: J1
	1-80356A08	ASSEMBLY CABLE, coaxial
	1-80350A31	ASSEMBLY, CABLE & CONNECTOR, includes: J1
	30-859004	CABLE, coaxial RG 188U; 18" used

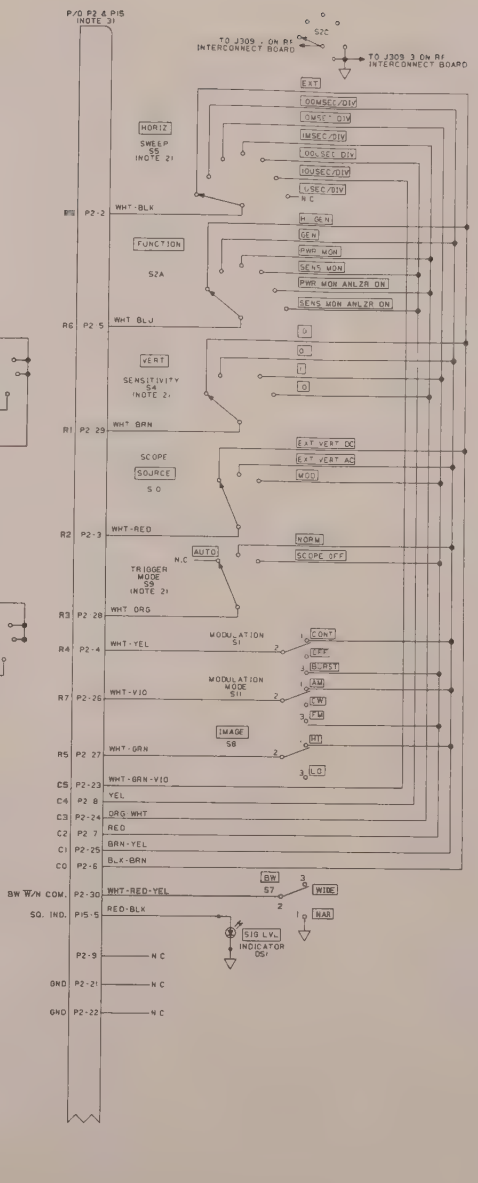
RPX4249B Fuse Replacement Kit

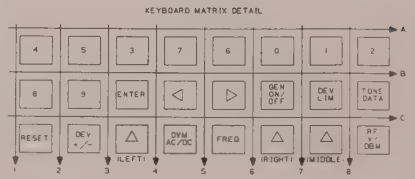
PL-8981-O

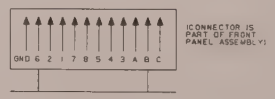
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse:
F2	65-80397A22	8 amp; 32 V
F3	65-20404	3 amp; 250 V
F4	65-474899	1/8 amp; 250 V (110 V operation)
	or 65-80377A61	0.1 amp; 250 V (220 V operation)

FRONT PANEL









EEPS-42500-0

NOTES

1. Unless otherwise specified, all resistor values are in ohms, all capacitor values are in microfarads, and all inductor values are in microhenries.
2. Potentiometers R5, R8, and R10 are ganged with switched S4, S5, and S9, respectively.
3. R2400A Service Monitor with Spectrum Analyzer uses two 30-pin connectors (P2 and P15) as shown.
4. S2A, S2B, S2C, and S2D is a 4-pole 6-position switch.

Motorola No. ***PEPS-42542-O***
9/13/85 **-PHI**

MOTOROLA INC.

instruction manual revision

INSTRUCTION MANUAL REVISION

GENERAL:

This revision outlines changes that have occured since the printing of your instruction manual. Use this information to correct your manual.

MANUAL AFFECTED:

68P81069A69-O, R2200B Communications Service Monitor Maintenance Manual

REVISION DETAILS:

Behind the REFERENCE/AUDIO MODULE tab, locate the TCXO/ OCXO Board.

Change C1 to 0.01 uF, 50 V, Motorola Part. No. 08-11017A08

Change C6 to 1.0 uF, 35 V, Motorola Part No. 23-83441B15
NOTE: This is a polarized capacitor and must be mounted so that the '+' lead is nearest the center of the board.

SMR-5105
8/18/86

INSTRUCTION MANUAL REVISION

SMR-5426 01-05-88

GENERAL:

This revision outlines changes to the **R2200/R2400** that may have occurred since the printing of your manual.

INSTRUCTION MANUAL AFFECTED: 68P81069A69-O

REVISION DETAILS:

1. A spring style washer and two wire mesh washers have been added to the RTL-4125B hardware kit. The spring washer part number 04-00852407 is inserted over the "N" connector on the RF module before the RF module is inserted into the chassis. The two wire mesh washers are used in conjunction with the spring and flat washer that are already in use. The spring and then the flat washer is placed over the step attenuator shaft. The wire mesh washer part number 32-80374B30 is then placed over the step attenuator shaft. Wire mesh washer part number 32-80374B31 is inserted over the RF vernier shaft in the same manner. After these three washers are installed the RF module can be installed in the chassis.

   Behind the tab, CHASSIS MECHANICAL, in the manual locate the RTL-4125B hardware kit and make the changes as described below:

Non-referenced Items

	MOTOROLA PART NO.	DESCRIPTION
ADDED PARTS:		
	04-00852407	Spring washer
	32-80374B30	Mesh washer
	32-80374B31	Mesh washer

2. The following part changes have been made to the RF Synthesizer board (Model RTC1001B):

Part Reference #	Old Number	New Number
R332,333	0611041C52 300 ohm 1/8W	0611041C56 430 ohm 1/8W
R334	0611041C23 18 ohm 1/8W	0611041C19 12 ohm 1/8W
VR201	4883193A59 5.6V Zener diode	4883696E07 6.2V Zener diode

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Communications Sector

SMR-5633 02-13-89

INSTRUCTION MANUAL REVISION

GENERAL: This Instruction manual Revision outlines changes that have occurred since the printing of the manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED: **68-81069A69-0 ,SERVICE MONITOR** MODELS: R2200B,R2400A, **SERVICE MANUAL.**

REVISION DETAILS:

Changes on schematic # PEPS-36850-A and Parts List, RTC-4023A, CPU Board:

NOTE: RTC-4023A Replaced with RTC-4056A CPU Board Assembly.

Delete:	51-83652M55	U2, U3	512x4 RAM.
Add:	51-02156C19	U2, U3	1kx4 CMOS RAM.
Delete:	51-80397A23	U4	PROM Firmware.
Add:	51-80323B19	U4	PROM Firmware version 1.03 (lower).
Delete:	51-80397A24	U22	PROM Firmware.
Add:	51-80323B20	U22	PROM Firmware version 1.03 (upper).

Changes on schematic # PEPS-36851-B and Parts List, RTL-4106A, Counter Board:

The schematic diagram should show a connection from U3 pin 15 to R107; and from the other side of R107 a connection to +5VF supply.

Add:	06-11009C73	10K	R107

Refer to SMR# 4951 for other corrections.

Changes on schematic # PEPS-36843-A and Parts List, RTP-4020B, Scope Supply:

Delete:	18-83452F32	10K	R13.
Add:	18-83452F33	20K	R13.
Add:	06-11009C89	47K	R13A

Changes on schematic # PEPS-36841-A and Parts List, RTC-4021B, Scope Driver:

Delete:	06-10621A97	100.	R65, R71.
Add:	06-11049B31	220.	R65, R71.
Delete:	06-80378A20	47.5K	R46, R54.
Add:	06-80390A94	56.2K	R46, R54.

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Manual changes cont"d.

Changes on schematic # PEPS-37053-A and Parts List, RTC-1004B, Scope Module:

Delete:	24-80377A26	L1	Twist Coil.
Add:	24-80379B62	L1	Twist Coil

Changes on schematic # PEPS-36854-A and Parts List, RTL-4093A, W.B.A. Board:

NOTE: RTL-4093A Replaced with RTL-4204A Wideband ampl. assembly.

Delete:	48-80366B83	CR206, CR207, CR208	PIN Diode.
Add:	48-83510F01	CR206, CR207, CR208	PIN Diode.
Delete:	24-82549D28`	L212	10.uH. choke.
Add:	24-82549D25	L212	10.uH. choke.

Changes on schematic # PEPS-36842-A and Parts List, RTP4019B, Scope Bias Board:

Delete:	48-83461E30	VR1, VR4	56 v zener.
Add:	48-80378A47	VR1, VR4	62.v zener.

Changes on schematic # PEPS-36856-A and Parts List, RTL4097,4098A, TCXO Board:

Delete:	21-832501	C1	.01uF.
Add:	08-11017A08	C1	.01uF.
Add:	23-83441B15	C6	1.0uF.

Note: This is a polarized capacitor and must be mounted so that the "+" lead is nearest the center of the board.

NOTE: RTL-1014B Replaced with RTL-1037B RF Module for R2200B.
and RTL-1034A RF Module for R2400A.

Changes on page 1 of Accessories (68P81065E11-0) Section 1.2 Step 1.

Should call out: 20 AWG wire size for up to 6 feet.
18 AWG wire size for up to 16 feet.

NOTE: If the keyboard stops accepting entries during programming frequency information it maybe neccessary to turn off and on the AC power switch to reset the service monitor.

NOTE: For information on Optional Two Way Service module assembly RTL-4161A obtain manual # 68-81124E23.

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INSTRUCTION MANUAL REVISION

SMR-5691 8/23/89 PAGE 1 OF 1.

GENERAL: This Instruction manual revision outlines changes that have occured since the printing of the manual. Use this information to correct your manual.

INSTRUCTION MANUAL AFFECTED: 68-81069A69-0 ,SERVICE MONITOR MODELS: R2200B,R2400A, SERVICE MANUAL.

Changes on schematic # PEPS-36854-A and Parts List, RTL-4093A, W.B.A. Board:

NOTE: RTL-4093A Replaced with RTL-4204A Wideband ampl. assembly.

Delete:	21-13740B09	C228	Capacitor, chip, 2.2 pf.
Add:	21-13740B27	C228	Capacitor, chip, 12.pf.
Delete:	21-13740B29	C229	Capacitor, chip, 15.pf.
Add:	21-13740B27	C229	Capacitor, chip, 12.pf.
Add:	21-84494B36	C263	Capacitor, Mica, 13.pf.

Connect C263 across R 287.

Changes on schematic # PEPS-42539-0 and Parts List, RTL-4205A, IF Board:

Delete:	21-11031F07	C108,109,119,120,151,152,153,154 Cap,3.3pf	
Add:	21-13740B13	C108,109,119,120,151,152,153,154 Cap,3.3pf	
Delete:	21-11013B10	C104,C115	Cap., chip, 5.6 pf.
Add:	21-13740B19	C104,C115	Cap., chip, 5.6 pf.

Changes Parts List ,RTC-1004B Scope Module:

Delete:	24-80377A06	Twist coil
Add:	24-80379B62	Twist coil

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R-2200B COMMUNICATIONS SERVICE MONITOR

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FOREWORD

1. SCOPE OF MANUAL

This manual is intended for use by technicians experienced with similar types of equipment. It contains all the service information required for the equipment described and is current as of the printing date. Changes which occur after the printing date are incorporated by Instruction Manual Revisions (SMR). These SMR's are added to the manuals as engineering changes are incorporated into the equipment.

2. MODEL AND KIT IDENTIFICATION

Motorola equipments are specifically identified by an overall model number on the nameplate. In most cases, assemblies and kits which make up the equipment also have kit model numbers stamped on them. When a production or engineering change is incorporated, the applicable schematic diagrams are updated.

3. SERVICE

The Motorola Test Equipment Service Center is charged with the service responsibility for all test equipment supplied by the Motorola Communications Sector. The center maintains a stock of original equipment replacement parts and a complete library of service information for all Motorola test equipment.

Most in-warranty repairs are performed at the center. Exceptions include repairs on some equipment not manufactured by Motorola which are performed by the original supplier under the direction of the Motorola Test Equipment Service Center. Out-of-warranty service is performed on a time and materials basis at competitive rates. Customer satisfaction is continually surveyed by reply cards returned with repaired instruments.

The Motorola Test Equipment Service Center also provides a convenient telephone troubleshooting service. Frequently, a user technician can troubleshoot a piece of equipment and isolate the defective components under the direction of the Motorola Test Equipment Service Center via telephone. Required replacement parts are then immediately shipped to the user thereby reducing shipping time and servicing costs. For telephone troubleshooting, contact the Motorola Test Equipment Service Center toll free at 1-800-323-6967.

All other inquires and requests for test equipment calibration and repairs should be directed to the Motorola Area Parts Office. They will contact the Motorola Test Equipment Service Center, process the necessary paperwork and, if necessary, have the Center contact you to expedite the repair.

4. REPLACEMENT PARTS ORDERING

Motorola maintains a number of parts offices strategically located throughout the United States. These facilities are staffed to process parts orders, identify part numbers, and otherwise assist in the maintenance and repair of Motorola Communications products.

Orders for all replacement parts should be sent to the nearest area parts and service center listed below. When ordering replacement parts, the complete identification number located on the equipment should be included.

5. ADDRESSES

5.1 GENERAL OFFICES

MOTOROLA Communications and Electronics Inc.
Communications & Electronics Parts
1313 E. Algonquin Rd.,
Schaumburg, Illinois 60196
Phone: 1-312-576-3900

5.2 U.S. ORDERS

WESTERN AREA PARTS
1170 Chess Drive, Foster City
San Mateo, California 94404
Phone: 1-415-349-8621
TWX: 910-375-3877

MIDWEST AREA PARTS
1313 E. Algonquin Rd
Schaumburg, Ill. 60196
Phone: 1-312-576-7430
TWX: 910-693-0869

MID-ATLANTIC AREA PARTS
7230 Parkway Drive
Hanover, Maryland 20176
Phone: 1-301-796-8763
TWX: 710-862-1941

EAST CENTRAL AREA PARTS
12995 Snow Road
Parma, Ohio 44130
Phone: 1-216-433-1560
TWX: 810-421-8845

EASTERN AREA PARTS
85 Harristown Road
Glenrock, New Jersey 07452
Phone: 1-201-444-9662
TWX: 710-988-5602

GENERAL SAFETY INFORMATION

WARNING

The service monitor uses 1200 V high voltage in the scope module high voltage power supply (RTP4020B), high voltage board (RTP4019B), and near the cathode ray tube (CRT). Handle with extreme care to avoid electrical shock.

WARNING

The service monitor can operate from a 90 to 260 V ac power supply. When unit is ac power operated, ac is present at the back panel and on the low voltage power supply (RTP4018B). To avoid electrical shock, disconnect line cord before removing power supply or equipment cover.

WARNING

If improperly handled, the cathode ray tube (CRT) can implode and shatter. When working near the CRT, always wear safety glasses and handle CRT with extreme care.

WARNING

Lithium Battery

The processor (CPU) module within this system utilizes a lithium battery as a memory keep-alive voltage source. Do not mutilate or disassemble the battery cell. Lithium metal is a very active material that burns in the presence of water or high humidity. Do not put the battery in fire, attempt to charge, or heat above 100 °C. Do not overdischarge the cell to a reverse voltage greater than 3 volts. The battery may burst and burn or release hazardous materials.

CAUTION

Lithium Battery

Lithium batteries are classified as hazardous materials and must be disposed of accordingly. Do not dispose of the battery by placing it in with the everyday trash. Consult state and local codes for the appropriate disposal procedure. Motorola will dispose of the battery if the expended battery is returned in the replacement battery container and by the same method that the new battery came to you, send to: Motorola Inc., Return Goods Department, 1313 East Algonquin Road, Schaumburg, IL 60196.

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MOTOROLA, INC.
COMMUNICATIONS SECTOR
TEST EQUIPMENT SERVICE CENTER
1313 EAST ALGONQUIN ROAD SCHAUMBURG, ILLINOIS 60196

TEST EQUIPMENT SERVICE REQUEST FORM

This completed form must accompany equipment returned for service.

CUSTOMER'S PURCHASE ORDER NO.		DATE	
MODEL NUMBER		SERIAL NUMBER	
DESCRIPTION OF PROBLEM:			
REQUESTED SERVICE:			
SHIP TO ADDRESS:			
SHIP VIA:			

Providing the information below will reduce the turnaround time on your Test Equipment Service.

MOTOROLA CUSTOMER NUMBER	BILL TAG	SHIP TAG	INTERNAL MOTOROLA ACCOUNT NO.

SIGNED: _____

MOTOROLA INC.
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SPECIFICATIONS, DESCRIPTION, AND OPERATION

The Specifications, Description, Operation, and Operating Instructions sections are contained in the R-2200B Communications Service Monitor Operators' Manual, Motorola part number 68P81069A79. Refer to the Operators' Manual as required.

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SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES

Many of the integrated circuit devices used in communications equipment are of the CMOS (Complementary Metal Oxide Semiconductor) type. Because of their high open circuit impedance, CMOS ICs are vulnerable to damage from static charges. Care must be taken in handling, shipping, and servicing them and the assemblies in which they are used.

Even though protection devices are provided in CMOS IC inputs, the protection is effective only against overvoltage in the hundreds of volts range such as are encountered in an operating system. In a system, circuit elements distribute static charges and load the CMOS circuits, decreasing the chance of damage. *However, CMOS circuits can be damaged by improper handling of the modules even in a system.*

To avoid damage to circuits, observe the following handling, shipping, and servicing precautions.

1. Prior to and while servicing a circuit module, particularly after moving within the service area, momentarily touch *both* hands to a bare metal earth grounded surface. This will discharge any static charge which may have accumulated on the person doing the servicing.

NOTE

Wearing Conductive Wrist Strap (Motorola No. RSX-4015A) will minimize static buildup during servicing.

WARNING

When wearing Conductive Wrist Strap, be careful near sources of high voltage. The good ground provided by the wrist strap will also increase the danger of lethal shock from accidentially touching high voltage sources.

2. Whenever possible, avoid touching any electrically conductive parts of the circuit module with your hands.

3. Normally, circuit modules can be inserted or removed with power applied to the unit. However, check the INSTALLATION and MAINTENANCE sections of the manual as well as the module schematic diagram to insure there are no objections to this practice.

4. When servicing a circuit module, avoid carpeted areas, dry environments, and certain types of clothing (silk, nylon, etc.) because they contribute to static buildup.

5. All electrically powered test equipment should be grounded. *Apply* the *ground lead* from the test equipment to the circuit module *before* connecting the *test probe*. Similarly, *disconnect* the *test probe prior* to removing the *ground lead*.

6. If a circuit module is removed from the system, it is desirable to lay it on a conductive surface (such as a sheet of aluminum foil) which is connected to ground through 100k of resistance.

WARNING

If the aluminum foil is connected directly to ground, be cautious of possible electrical shock from contacting the foil at the same time as other electrical circuits.

7. When soldering, be sure the soldering iron is grounded.

8. Prior to connecting jumpers, replacing circuit components, or touching CMOS pins (if this becomes necessary in the replacement of an integrated circuit device), be sure to discharge any static buildup as described in procedure 1. Since voltage differences can exist across the human body, it is recommended that only one hand be used if it is necessary to touch pins on the CMOS device and associated board wiring.

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9. When replacing a CMOS integrated circuit device, leave the device in its metal rail container or conductive foam until it is to be inserted into the printed circuit module.

10. All low impedance test equipment (such as pulse generators, etc.) should be connected to CMOS device inputs after power is applied to the CMOS circuitry. Similarly, such low impedance equipment should be disconnected before power is turned off.

11. Replacement modules shipped separately from the factory will be packaged in a conductive material. Any modules being transported from one area to another should be wrapped in a simlar material (aluminum foil may be used). NEVER USE NON-CONDUCTIVE MATERIAL for packaging these modules.

SYSTEM MAINTENANCE AND TROUBLESHOOTING

1. GENERAL

1.1 This instruction section includes system maintenance and troubleshooting information which will assist a technician in keeping the service monitor operating properly.

1.2 If additional assistance should become necessary, the Motorola Test Equipment Service Center provides a convenient telephone troubleshooting service. Frequently, a technician can troubleshoot a piece of equipment and isolate the defective components under the direction of the Motorola Test Equipment Service Center via telephone. Required replacement parts are then immediately shipped to the user thereby reducing shipping time and servicing costs. For telephone troubleshooting, contact the Motorola Test Equipment Service Center toll free at 1-(800) 323-6967.

1.3 All other inquiries and requests for test equipment calibration and repairs should be directed to the Motorola Area Parts Office. They will contact the Motorola Test Equipment Service Center, process the necessary paperwork and, if necessary, have the Center contact you to expedite the repair. Addresses and telephone numbers of Motorola Parts Offices are shown in the Foreword of this manual.

2. LIST OF MAJOR ASSEMBLIES

A list of major assemblies, including assembly number and Motorola kit number, is given in Table 1.

3. SYSTEM THEORY OF OPERATION

(Refer to Figure 1.)

3.1 LOW VOLTAGE POWER SUPPLY

The low voltage power supply consists of two printed circuit boards: the main board and the control board. The outputs are +5 volts, −5 volts, +12 volts, −12 volts, and +33 volts. The supply operates as a switching regulator for greater efficiency and is powered by either an ac or dc source. An internal battery is also available as an option. The power supply provides for overvoltage protection, overcurrent protection, and battery charging.

Table 1. List of Major Assemblies

Assembly/Subassembly Name	Motorola Kit Number
Rear Panel	—
Low Voltage Power Supply	RTP4018B
Scope Module	RTC1004B
High Voltage Board	RTP4019B
High Voltage Power Supply Board	RTP4020B
Driver Board	RTC4021B
Scope Amplifier Board	RTL4022A
RF Synthesizer Module	RTC1001B
Digital Board	RTC4009B
RF Board	RTC4010B
Receiver Board	RTL4134B
Analog Interface Board	RTL4092B
CPU Board	RTC4023A
Counter Board	RTL4106A
RF Module	RTL1014B
Wideband Amplifier Board	RTL4093A
Wattmeter Board	RTL4094A
RF Interconnect Board	RTL4095B
Tone Synthesizer Board	RTL4096A
Reference/Audio Module	RTL4097A (TCXO)/ RTL4098A (OCXO)
Front Panel Interface Board	RTL4100A
Front Panel Display Board	RTL4101A
Battery Pack	RTP4021A
Chassis Mechanical Less Rear Panel and Main Interconnect Board	RTX1008B
Main Interconnect Board	RTL4099B
Front Panel	—

3.2 REAR PANEL

The rear panel contains the ac power module, ac line filter, auxiliary power transformer, system cooling fan, EXT DC/BATTERY switch, and the dc fuse. The ac power module is the main ac fuseholder and is also used to set the line operating voltage. Line selection is accomplished with a small printed circuit board located behind a clear protective panel. The position in which the card is inserted determines the line voltage, either 110 volts or 220 volts. From the switch, ac power is routed through the ac line filter to the auxiliary power transformer. The fan provides cooling when power is on. The EXT DC/BATTERY switch selects either the internal battery or an external dc source which are both routed through the dc fuse.

3.3 MAIN INTERCONNECT BOARD

The main interconnect board provides a common interface for all modules and printed circuit boards including power, data and address lines, and other necessary wiring. A delay circuit prevents voltage surges when switching from STBY to the ON mode of operation. Additional filtering of the voltage to the rf synthesizer board is also provided by the main interconnect board. The front panel wiring harness plugs into this board.

3.4 REFERENCE/AUDIO MODULE

This board provides the service monitor with a 10 MHz frequency standard and audio amplifiers for audio signals from the receivers.

3.5 RF GENERATOR

3.5.1 RF signals are generated in the rf synthesizer and then routed to the rf module. From here the signal is amplified to 1 volt rms, sent through the step attenuator to either the antenna jack or the RF IN/OUT jack, depending on whether the HI GEN or GEN mode is selected. The front panel LCD displays the generated level in either dBm or volts.

3.5.2 Modulation of the rf carrier is obtained by routing the desired modulation signal (1 kHz, code synthesizer, or external) through the front panel interface board (FPI) to the rf synthesizer. The buffered signal is used by the rf synthesizer to perform AM or FM modulation on the carrier, and the front panel display allows the operator to view the amount of FM deviation or %AM.

3.6 MONITOR

The rf signal applied to the antenna jack is routed to the rf module where it is mixed with the local oscillator frequency that results in a 10.7 MHz i-f. The receiver board filters, amplifies, and performs detection on the i-f and sends the recovered audio signal to the speaker amplifier and the analog interface board. One of the functions of the analog interface board is to detect the audio peaks to extract the FM deviation levels as well as the %AM measurements. The 10.7 MHz signal is routed to the counter board input where frequency error measurements are made. The squelch potentiometer and the signal level indicator LED located on the service monitor front panel are physically mounted on the receiver board via the main interconnect board.

3.7 RF WATTMETER AND LOAD

The 50-ohm load and wattmeter circuitry eliminate the need for an external load and wattmeter. The 125-watt load is located on the rf wattmeter board. The rf module detects the rf power applied at the RF IN/ OUT jack and sends a dc voltage proportional to the ac rms level to the analog interface board, counter, and the CPU where it is scaled and displayed on the LCD. Compensation for slight variations of the wattmeter circuitry are corrected by the custom PROM on the rf module.

3.8 DIGITAL VOLTMETER (AC, DC, SINAD, DISTORTION)

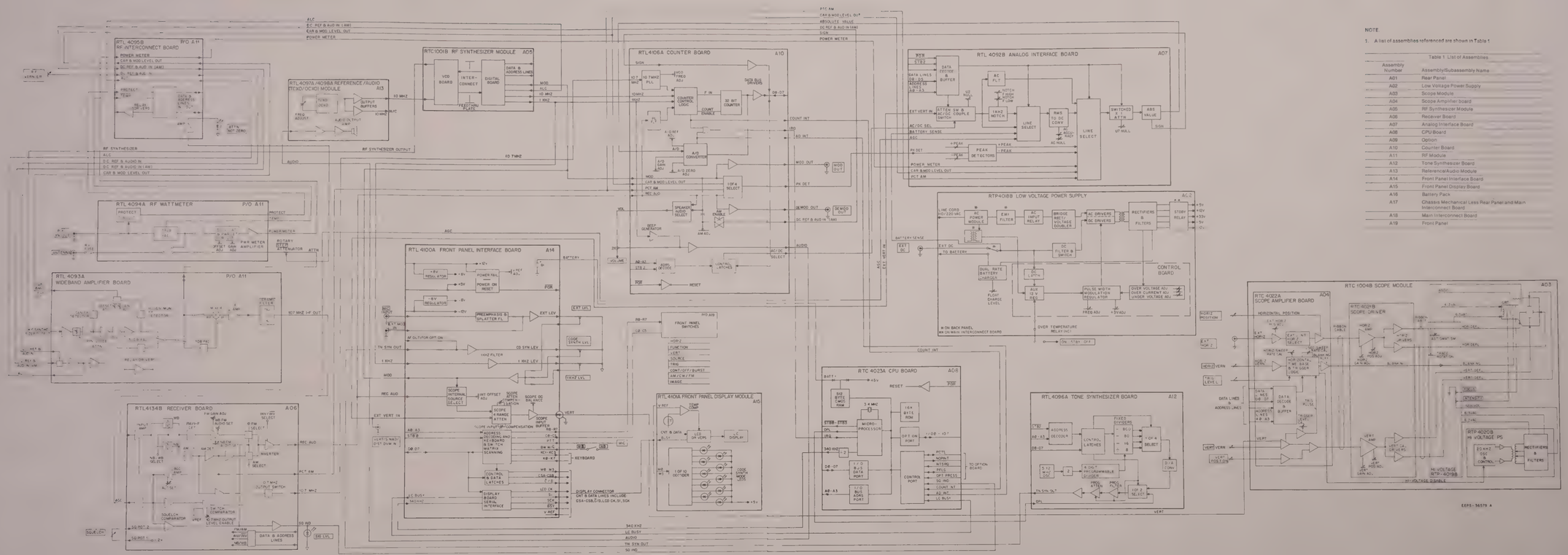
When a signal is being measured, it is applied to the VERT/SINAD/DIST/DVM IN jack on the front panel. The signal is routed to the analog interface board when it is coupled to the rms/dc converter and is passed through either the ac or dc path. The absolute dc value is sent to the counter and after passing through the A/D converter it goes to the CPU for processing and display. The SINAD and distortion measurements are processed similarly except that a 1 kHz notch is added. The DVM ranging is performed automatically by the CPU control of the relay switching on the analog interface board.

3.9 OSCILLOSCOPE

All signals displayed by the oscilloscope are routed to the scope vertical input through the front panel interface board. Depending upon the mode selected, the appropriate signals are passed through the scope amplifier and driver boards to the CRT. The oscilloscope can be used either with an external vertical input or as a modulation monitor. In the external vertical mode, ac or dc coupling is available. Horizontal sweep can be from either an external or internal source.

3.10 CODE SYNTHESIZER/AUDIO GENERATION

The code synthesizer is programmed by the CPU to generate tones and DPL (Digital Private-Line™) codes. The tones are routed to the front panel interface board and then to the rf synthesizer where a 1 kHz signal is generated for use in keyboard entry verification and modulation. The code synthesizer operates independently of the function switch setting.



NOTE

1. A list of assemblies referenced are shown in Table 1

Table 1 List of Assemblies

Assembly Number	Assembly/Subassembly Name
A01	Rear Panel
A02	Low Voltage Power Supply
A03	Scope Module
A04	Scope Amplifier board
A05	RF Synthesizer Module
A06	Receiver Board
A07	Analog Interface Board
A08	CPU Board
A09	Option
A10	Counter Board
A11	RF Module
A12	Tone Synthesizer Board
A13	Reference/Audio Module
A14	Front Panel Interface Board
A15	Front Panel Display Board
A16	Battery Pack
A17	Chassis Mechanical Less Rear Panel and Main Interconnect Board
A18	Main Interconnect Board
A19	Front Panel

Figure 1. R-2200 Communications Service Monitor System Signal Flow and Functional Block Diagram

Service Kit RPX-4239A

01-80350A32	L.V.P.S. Extender Board (1)
01-80350A33	C.P.U. Extender Board (1)
01-80350A34	Digital Extender Board (1)
01-80350A35	F.P.I. Extender Board (1)
01-80350A36	L.V.P.S. Control Extender Board (1)
01-80350A41	Synthesizer Extender (1)
01-80307A70	Extender Ribbon Cable (2)
01-80308A72	Extender R.F. Cable (2)
01-80356A22	Synthesizer Output Check (1)
01-80350A40	9-Conductor Extender Cable (1)
01-80351A14	Extender Cable (1)

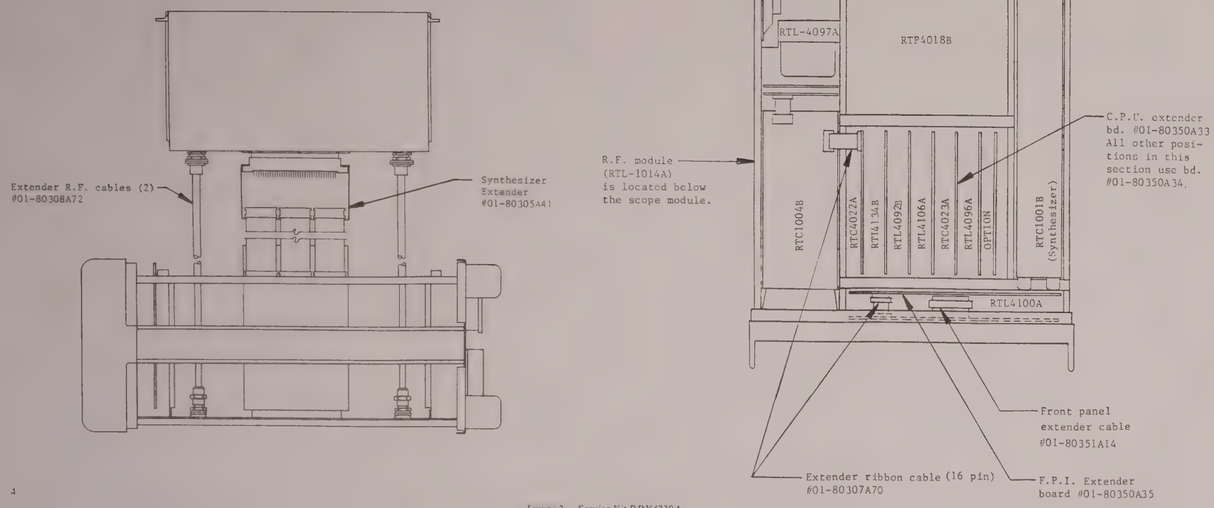

Extender R.F. cables (2) #01-80308A72
Synthesizer Extender #01-80305A41
Synthesizer output check cable #01-80356A22. Disconnect R.F. cable between bkt. on back panel and R.F. module casting at the bracket.
L.V.P.S. Extender Board #01-80350A32 and 9 conductor extender cable # 01-80350A40. L.V.P.S. control extender board #01-80350A36 for L.V.P.S. control board.
RTL-4097A
RTP4018B
R.F. module (RTL-1014A) is located below the scope module.
C.P.U. extender bd. #01-80350A33 All other positions in this section use bd. #01-80350A34.
RTC1004B
RTC4022A
RTL4134B
RTL4092B
RTL4106A
RTC4023A
RTL4096A
OPTION
RTC1001B (Synthesizer)
RTL4100A
Front panel extender cable #01-80351A14
Extender ribbon cable (16 pin) #01-80307A70
F.P.I. Extender board #01-80350A35

Figure 2. Service Kit RPX4239A

4. SERVICE KIT RPX4239A

An optional Service Kit RPX4239A is available which contains extender cards and cables for easier servicing. The service kit is described in Figure 2.

5. PREVENTIVE MAINTENANCE

5.1 CLEANING

The liquid crystal displays (LCDs) and oscilloscope graticule should be cleaned periodically using a damp, soft cloth with a mild detergent.

5.2 STORAGE AND OPERATING ENVIRONMENTS

The service monitor should be operated in an environment with an ambient temperature between 0°C and +55°C. The service monitor should be stored in an environment with an ambient temperature between −40°C to +85°C.

Figure 2. Service Kit RPX4239A

5.3 REFERENCE MODULE (TCXO/OCXO) OSCILLATOR CHECK

The reference oscillator in the reference module should be checked once a year as described in the Adjustment, Alignment, and Calibration Procedures instruction section (68P81065E08) in this manual.

5.4 RECALIBRATION

The service monitor should be recalibrated yearly to assure performance to specifications. The calibration procedure is included in the Adjustment, Alignment, and Calibration Procedures instruction section (68P81065E08) in this manual.

6. AC INPUT POWER MODULE ADJUSTMENT

The service monitor is set for 110-130 V ac operation at the factory. For operation from 100-110 V ac or 200-260 V ac, the voltage selection card must be readjusted before connection to the power source. This is accomplished by the following procedure.

Step 1. Remove the power cord from the rear panel connector.

Step 2. Slide the selector card cover door over the connector area exposing the selection card and fuse area.

Step 3. Pull outward on the fuse ejector tab and remove fuse.

Step 4. Remove the printed circuit board voltage selector card by pulling straight to the rear.

Step 5. Reinsert the card at the orientation which causes the appropriate voltage range (marked on card) to be displayed.

Step 6. Reinstall the fuse.

Step 7. Slide the cover plate back to the original position, connect power cord, and proceed with system operation.

7. REMOVAL OF SCOPE MODULE (RTC1004B)

Step 1. To gain access to the printed circuit boards and modules, turn off the power and remove the top cover. The service monitor should be unplugged for added safety.

Step 2. Using an Allen wrench, loosen the lock screws holding the INTENSITY and FOCUS knobs on the front panel and remove the knobs.

Step 3. Disconnect the 16-conductor ribbon cable from the scope amplifier board (RTC4022B).

Step 4. Loosen six screws holding the scope amplifier module to the chassis.

Step 5. Position the service monitor in the upright position and remove the six screws holding the module in place. Work the module backward until the FOCUS and INTENSITY shafts are behind the front panel, and the CRT face is behind the bezel which surrounds the front panel.

CAUTION

A spring and washer are on both the FOCUS and INTENSITY shafts. Care should be taken to avoid pointing the shafts below horizontal level so that the spring and washer do not slide off.

Step 6. Pull the module out a few inches, allowing enough room to reach inside, and disconnect the 4-pin connector from the scope high voltage power supply.

Step 7. Remove the module by pulling straight out until the entire CRT and shield are out. Tilt the rear of the module to prevent damaging the FOCUS and INTENSITY shafts.

8. TROUBLESHOOTING

Table 2 provides general system troubleshooting information.

Table 2. R-2200 Service Monitor System Troubleshooting Chart

Symptom	Probable Cause	Check
Variation of RF VERNIER control produces no change in the displayed rf level in HI GEN function.	Inadequate detected rf (dc level) at U207 input (RTL4093A).	• U203, U204, and/or U205 not functioning. • L217 and/or L218 are open. • CR217 not functioning.
Same as above except in GEN function.	Inadequate detected rf (dc level) at U207 input (RTL4093A).	• CR231 not functioning. • Broken lead on RF VERNIER control R320 (RTL4095B).
Little or no rf output in HI GEN function.	Open fuse in ANTENNA connector (J6).	• Replace fuse.
	Relay (K202) does not close (RTL4093A).	• Check relay coil (normally 300-400 ohms). • Check rf path.
	No 10 MHz reference (RTL4097A/98A).	• Check TCXO output. • Check all related hardline and connections.
	No injection from rf synthesizer (RTC1001B).	• Check rf synthesizer injection to rf module. • Check all related hardline and connections. • Check wideband amplifier (RTL4093A) and rf path.
Little or no rf output in GEN function.	Relay (K203) does not close (RTL4093A).	• Check relay coil (normally 300-400 ohms). • Check rf path.
	No 10 MHz reference (RTL4097A/98A).	• Check TCXO output. • Check all related hardline and connections.
	No injection from rf synthesizer (RTC1001B).	• Check rf synthesizer injection to rf module. • Check all related hardline and connections.
No reception in SENS MON function.	No 10 MHz reference (RTL4097A/98A).	• Check TCXO output. • Check all related hardline and connections.
	No injection from rf synthesizer (RTC1001B).	• Check rf synthesizer injection to rf module. • Check all related hardline and connections.
	No mixer injection to receiver board (RTL4134B).	• Check position of rotary STEP attenuator. • Check fuse in ANTENNA jack (J6). • Check coils of K201, 4 (RTL4093) (normally 300-400 ohms).
No HI GEN or GEN function modulation.	Modulation source not getting to rf synthesizer.	• Check MOD line on main interconnect board (RTL4099B). • Check 1 kHz or CODE SYNTHESIZER OUT or EXT MOD IN signals at front panel interface board (RTL4100A).
Unit fails to power up (ac operation).	Failure in power supply (RTP4018B).	• Check fuses. • Check output lines [voltages marked on main interconnect board (RTL4099B)] for short circuits to ground. • Check power supply.
Unit fails to power up (dc operation) (battery or external).	Failure in power supply (RTP4018B).	• Check fuses. • Check EXT DC/BATTERY switch for proper position. • Check output lines [voltages marked on main interconnect board (RTL4099B)] for short circuits to ground. • Check battery. • Check power supply.

Table 2. R-2200 Service Monitor System Troubleshooting Chart (Cont'd.)

Symptom	Probable Cause	Check
No scope trace. No spot on CRT.	No output from HV power supply (RTP4020A).	• Check for voltages; −1200 V dc, +140 V dc, 6.3 V ac (filament). **WARNING** The service monitor uses 1200 V high voltage in the scope module RTP4020A High Voltage Power Supply, RTP4019A High Voltage Board, and near the cathode ray tube (CRT). Handle with extreme care to avoid electrical shock.
	Bad CRT.	• Check for filament glow.
	No vertical or horizontal from scope amplifier.	• Check pin 1 with respect to pin 3 (RTC4022A) should be −5 V variable with VERT/HORIZ POSITION controls.
	Bad CRT.	• Check for filament glow.
	No vertical or horizontal from scope amplifier.	• Check pin 1 with respect to pin 3 (RTC4022B) should be −5 V variable with VERT/HORIZ POSITION controls.
Spot in center of CRT.	No drive from scope amplifier (RTC4022B).	• Check ribbon cable from scope amplifier to driver board.
No keyboard response tone and/or no 1 kHz.	10 MHz timebase not getting to rf synthesizer (RTC1001B).	• Check TCXO output (RTL4097A/98A). • Check all related hardline and connections. • Check rf synthesizer (RTC1001B). • Check for tone on FPI socket (RTL4100A) when key is depressed.
Counter does not work for PL signals.	No 10 MHz getting to counter module (RTL4106A).	• Check 10 MHz line to counter module. • Check counter module.
Unit turns on but displays are blank (PL COUNT LED on).	Power on reset signal stuck at low level.	• Check voltage at J1-9 on front panel interface board (RTL4100A), should be 7.00 V dc. Adjust R80 if necessary. • Check RTL4100A reset circuitry.
	LC BUSY signal is stuck at high level.	• Check RTL4100A. Edge connector pin 2 should be TTL low signal. • If high, disconnect display board (RTL4101A). If signal goes low — check display module.
	No 170 kHz clock to the display module.	• Check RTL4100A edge connector pin 4 for 340 kHz.
Unit turns on but all displays remain off (no response from front panel).	IRQ signal stuck low.	• Check RTL4106A edge connector pin 70 for high signal.
Over power on (unit in GEN and no rf input).	RF module disconnected.	• Seat 24-pin header securely into socket on rf interconnect board (RTL4095B). • Check output of comparator on rf I/O module (RTL4092A).
Any part of the non-volatile memory fails to retain information.	Discharged battery.	**WARNING** Lithium battery — do not mutilate or disassemble. Lithium metal is a very active metal that burns in the presence of water or high humidity. Do not put the battery in fire, attempt to charge or heat above 100°C. Do not overdischarge the cell to a reverse voltage greater than 3 volts. The battery may burst and burn or release hazardous materials.

Table 2. R-2200 Service Monitor System Troubleshooting Chart (Cont'd.)

Symptom	Probable Cause	Check
		CAUTION Do not substitute another type lithium battery as a replacement. The battery was chosen with safety as a major consideration. Other lithium battery types may present a potential hazard when used in this system. **DISPOSAL** A. Do not dispose of the battery by placing in the everyday trash. Lithium batteries are classified as hazardous material and must be disposed of accordingly. B. Consult state and local codes for disposal procedure. C. Motorola will dispose of the battery for you if you send the battery in the shipping container and by the same method that the new battery came to you. Send to: Motorola, Inc. Return Goods Dept. 1313 E. Algonquin Rd. Schaumburg, IL 60196
		• Remove FPI (RTL4100A) from unit and place on non-conducting surface. • Measure the dc voltage across the lithium battery. If the voltage is less than 2.4 volts, the cell is discharged and should be replaced.
Code synthesizer output extremely distorted.	Tone synthesizer module (RTL4096A) D/A converter not working properly.	• Check related circuitry on tone synthesizer module (RTL4096A).
No code synthesizer modulation.		• Check for output from code synthesizer (RTL4096A) at edge connector pin 25. • Check for signal at FPI board (RTL4100A) edge connector pin 35.
No external modulation.		• Apply modulating signal to external modulation jack (EXT MOD IN). • Check for signal at FPI (RTL4100A) edge connector pin 36. • Check for signal at FPI (RTL4100A) edge connector pin 33 with the external level (EXT LVL) potentiometer fully clockwise.
Any keys on the front panel do not work.	Defective keyboard/connector.	• Ensure that the keyboard tail is securely plugged into the connector on the FPI (RTL4100A).
One or more positions on one or more switches on front panel do not operate.	Open path on switch scanning matrix.	• Check for defective switch. • Check for broken wire at switch or at connection near main interconnect board (RTL4099B).
Frequency error display reads 0.00 or 99.9 kHz with signal input and receiver unsquelched.	10.7 MHz PLL is misaligned.	• Follow counter module (RTL4106A) adjustment procedure to adjust 10.7 MHz PLL.
	Count enable signal is not being generated on the counter module (RTL4106A).	• Check counter module (RTL4106A) for count enable signal generation.
No audio output at speaker.		• Check audio feed signal at counter module (RTL4106A) edge connector pin 2. • Check audio amplifier (p/o RTL4097A/98A).
No SINAD, distortion or DVM measurements are displayed.	Signal not getting to analog interface board (RTL4092B).	• Check for signal at analog interface board (RTL4092B) edge connector pin 2. • Check analog interface board (RTL4092B).

ADJUSTMENT, ALIGNMENT, AND CALIBRATION PROCEDURES

1. INTRODUCTION

This section details procedures required to maintain the service monitor for optimum performance after replacing or repairing one of the modules or printed circuit boards. Specific adjustment, alignment, and calibration procedures are grouped under each individual subunit. A list of test equipment required to maintain the service monitor is included in paragraph 2 and the maintenance procedures are in paragraph 3.

2. TEST EQUIPMENT

The following is a list of test equipment that is required for proper maintenance and adjustment of the major assemblies of the R-2200 Service Monitor. Equivalent test equipment may be used if desired.

Assembly	Test Equipment Required
Plug-in Assemblies	Circuit Board Extender Kit RPX4239A
Scope Module RTC1004B	Tone Generator — Motorola R1100A Digital Multimeter (DMM) — Motorola R1024A
RF Module RTL1014B (less RF Wattmeter)	Digital Multimeter (DMM) — Motorola R1024A RF Signal Generator HP8640B — two required Spectrum Analyzer — HP8558B (with HP182T Display) Modulation Analyzer — HP8901A 0.1-1300 MHz, 48 dB gain amplifier — HP8447F
RF Wattmeter RTL4094A	Power Meter — HP436A with 25 W HP Power Sensor Directional Coupler — NARDA 3020A RF Millivoltmeter — S1339A 50-ohm BNC adapter for RF Millivoltmeter 450 MHz ± 5 MHz, 40 Watt RF power source with harmonic filter Digital Multimeter (DMM) — Motorola R1024A 3 dB, 50 Watt Attenuator — NARDA 765 6 dB, 20 Watt N-type Power Attenuator — NARDA 766 10 dB, 20 Watt Attenuator — NARDA 766 10 dB BNC Attenuator — NARDA 755 Miscellaneous assortment of cables and adapters (refer to test set-up diagram) (Figure 2)
Reference Module RTL4097A/RTL4098A	Frequency Counter (8 or more digits) Systron Donner 6243A Frequency Standard — 1 part in 10^9 or better — 1 MHz
Counter RTL4106A	Digital Multimeter (DMM) — Motorola R1024A Tone Generator — Motorola R1100A
Front Panel Interface RTL4100A	Digital Multimeter (DMM) — Motorola R1024A Audio Analyzer — HP8903A
Receiver RTL4134B	Digital Multimeter (DMM) — Motorola R1024A RF Signal Generator — Motorola R1201A 25-0-25 Microammeter Audio Analyzer — HP8903A
Low Voltage Power Supply RTP4018B	Oscilloscope — Motorola R1029A Digital Multimeter — Motorola R1024A
Analog Interface Board RTL4092B	Digital Multimeter (DMM) — Motorola R1024A RF Signal Generator — Motorola R1201A

3. ADJUSTMENT, ALIGNMENT, AND CALIBRATION PROCEDURES

3.1 SCOPE MODULE (RTC1004B) ADJUSTMENT PROCEDURE

Adjustments to the scope module circuit boards are made on one of three boards: scope amplifier (RTC4022B), scope driver (RTC4021B), and scope high voltage board (RTC4019B). Refer to the appropriate circuit board detail diagram for the location of specified potentiometers in the Scope Module section (68P81064E52) of this manual.

NOTE

Adjustments to the scope module *must* be made in the order indicated.

3.1.1 Scope High Voltage Board (R16 — Trace Rotation)

With no signal applied to VERT/SINAD/DIST/DVM IN jack and a trace displayed on the CRT, adjust R16 so that the trace is parallel with the horizontal graticule lines.

3.1.2 Scope High Voltage Board (R19 — Astigmatism)

With 1 kHz sine wave at 60 mV p-p (21.2 mV rms) applied to VERT/SINAD/DIST/DVM IN jack and VERT control set to .01 V/div., adjust R19 for the clearest trace.

NOTE

R9 located on the FPI (front panel interface) board *must* be adjusted before adjusting R63.

3.1.3 Scope Driver (R63 — Vertical Position)

With no input to VERT/SINAD/DIST/DVM IN jack, VERT control set to 10 V/div., and VERT control positioned at center of rotation, adjust R63 to vertically center the trace on the CRT.

3.1.4 Scope Driver (R70 — Vertical Gain Calibrate)

Apply a 1 kHz sine wave at 60 mV p-p (21.2 mV rms) to VERT/SINAD/DIST/DVM IN jack. Set VERT control at .01 V/div. and VERT vernier control to calibrate (CAL). Adjust R70 to obtain a trace that is 6 divisions peak-to-peak.

3.1.5 Scope Driver (R10 — Horizontal Position)

Adjust R10 to give the following: When the HORIZ POSITION control is fully clockwise, the *distance* from the start of the trace (to the rightmost vertical graticule line) is the same *distance* as the *distance* from the end of the trace (to the leftmost vertical graticule line) when the HORIZ POSITION control is fully counterclockwise.

3.1.6 Scope Amplifier (R7 — External Horizontal Position)

Apply a 1 kHz sine wave at 600 mV p-p (212 mV rms) to EXT HORIZ jack. Set the HORIZ switch to EXT. Adjust R7 fully counterclockwise. Set HORIZ POSITION control so that the trace starts at the second vertical graticule line (from left). Adjust R7 clockwise until the trace moves two divisions to the right.

3.1.7 Scope Amplifier (R40 — Horizontal Sweep Rate Calibrate and R11 Horizontal Gain)

Step 1. Adjust R11 fully counterclockwise. Set HORIZ to 1 mSec/div. Make sure HORIZ vernier is in CAL position (fully CW). Apply 1 kHz sine wave at 60 mV p-p (21.2 mV rms) to VERT/SINAD/DIST/DVM IN jack. Set VERT control to .01 V/div. — make sure VERT vernier is in CAL position. Adjust R40 for the display on CRT as shown in Figure 1A.

Step 2. Adjust R11 on scope driver board to expand the trace in Figure 1A to 1 peak-per-vertical division.

3.1.8 Scope Amplifier (R81 — Trigger Level Calibrate)

NOTE

The input signal, VERT, and HORIZ front panel adjustments are the same as for R40 and R11 in 3.1.7.

Adjust TRIG LEVEL control (front panel) to center of range. Center the trace vertically on the CRT using VERT POSITION control, if necessary. Adjust HORIZ POSITION on the front panel, if necessary, such that the start of trace is visible. Adjust R81 so that the beginning of the trace starts at and touches the center horizontal graticule (Figure 1B).

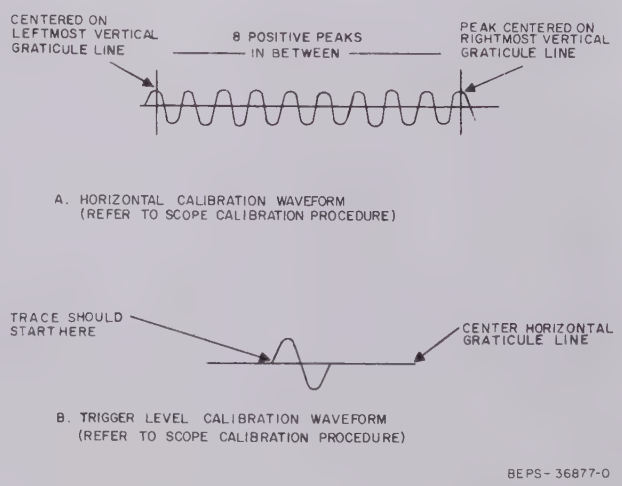

CENTERED ON LEFTMOST VERTICAL GRATICULE LINE
8 POSITIVE PEAKS IN BETWEEN
PEAK CENTERED ON RIGHTMOST VERTICAL GRATICULE LINE
A. HORIZONTAL CALIBRATION WAVEFORM (REFER TO SCOPE CALIBRATION PROCEDURE)
TRACE SHOULD START HERE
CENTER HORIZONTAL GRATICULE LINE
B. TRIGGER LEVEL CALIBRATION WAVEFORM (REFER TO SCOPE CALIBRATION PROCEDURE)
BEPS-36877-O

Figure 1. Scope Calibration Waveforms

3.1.9 Scope Amplifier (C3 — uSec Sweep Rate Calibration)

Apply 100 kHz sine wave at 60 mV p-p (21.2 mV rms) to VERT/SINAD/DIST/DVM IN jack. Set HORIZ control to 10 uSec/div. Ensure that HORIZ vernier is in the CAL position. Adjust C3 for 1 peak of the sine wave per vertical graticule line.

3.2 REFERENCE MODULE (RTL4097A/ RTL4098A) ADJUSTMENT PROCEDURE

Step 1. Connect external frequency standard to frequency counter external reference input. Set counter to EXT. REF.

Step 2. Connect service monitor antenna port to frequency counter input.

Step 3. Turn on service monitor and allow to warm up for 10 minutes (20 minutes for models with oven controlled crystal oscillator).

Step 4. Set service monitor frequency to 950.0000 MHz, FUNCTION switch to HI GEN, and adjust output level to 0 dBm.

Step 5. Using an appropriate non-metallic tuning tool, adjust the service monitor reference oscillator until the frequency counter reads 950.00000 MHz ±1 count (±10 Hz). Service monitor is now calibrated to better than 1/2 part in 10^7.

NOTE

If there is no reason to suspect that the receiver requires alignment, then proceed to the receiver adjustment procedure (paragraph 3.4).

3.3 RECEIVER BOARD (RTL4134B) ALIGNMENT PROCEDURE

3.3.1 Discriminator Alignment

Step 1. Remove phono plug from receiver input. Place receiver board on an extender card.

Step 2. Set service monitor for AM/FM/CW switch to FM, BW switch to WIDE, and FUNCTION switch to SENS MON.

Step 3. Connect a 25 uA-0-25 uA ammeter from TP1A to TP1B (refer to receiver schematic diagram and circuit board detail).

Step 4. Apply a 10.7000 MHz signal at a level of −30 dBm (7100 uV approximately) frequency modulated ±75 kHz with a 1000 Hz tone to the phono jack on the receiver board.

Step 5. Tune L8 for 0 uA on the meter. Disconnect meter. Reduce signal level to −47 dBm (1000 uV).

Step 6. Connect an audio distortion analyzer to the end of R19 closest to the edge connector.

Step 7. Adjust L8 for minimum distortion on the distortion analyzer. L8 should only require ±1/4 turn.

3.3.2 Narrowband Filter Alignment

Step 1. Set service monitor FUNCTION switch to SENS MON, AM/CW/FM switch to FM, and BW switch to NAR.

Step 2. Apply a 10.7 MHz signal at a level of −47 dBm (1000 uV) frequency modulated ±10 kHz with a 1000 Hz tone to the receiver board input jack.

Step 3. Connect an audio distortion analyzer to the end of R19 closest to the board edge connector.

Step 4. Adjust L12 for minimum distortion as read on the distortion analyzer.

Step 5. Adjust L13 for minimum distortion.

Step 6. Adjust C82 for minimum distortion.

Step 7. Adjust C44 for minimum distortion.

Step 8. Repeat Steps 4, 5, 6, and 7 until minimum distortion is obtained.

3.4 RECEIVER BOARD (RTL4134B) ADJUSTMENT PROCEDURE

3.4.1 AGC Set (R59 and R54)

NOTE

Prior to doing the receiver board adjustment, ensure that the receiver is aligned; if not, then the alignment ***must*** precede the adjustment.

Step 1. Program the receiver frequency for 11.0000 MHz.

Step 2. Set FUNCTION switch to SENS MON.

Step 3. Disconnect the antenna so there is no input to ANTENNA or RF IN/OUT jacks.

Step 4. Connect a DMM probe to pin 1 of U5. Adjust R54 for 0.150 V dc (±.005 V dc).

Step 5. Connect a DMM probe to pin 7 of U5. Adjust R59 for 2.00 V dc (±.05 V dc).

3.4.2 %AM Calibration (R54)

Step 1. Set service monitor FUNCTION switch to SENS MON, FUNCTION switch to DEV/%AM,

AM/CW/FM switch to AM, BW switch to NAR, and SQUELCH control fully counterclockwise.

Step 2. Program the receiver frequency to 11.0000 MHz.

Step 3. Apply 11.0000 MHz signal at a level of −47 dBm (1000 uV) amplitude modulated 80% with a 1000 Hz tone to the antenna input.

Step 4. Adjust R54 for +80%AM modulation as displayed on the front panel LCD display.

3.4.3 WBFM Audio Set (R75)

Step 1. Set service monitor AM/CW/FM switch to FM, FUNCTION switch to SENS MON, BW switch to WIDE, and SQUELCH control fully counterclockwise. Remove phono plug from the receiver board.

Step 2. Apply a 10.7 MHz signal at a level of −47 dBm (1000 uV) frequency modulated ±75.0 kHz with a 1000 Hz tone to the phono jack on the receiver board.

Step 3. Connect an ac voltmeter (DMM preferred) to the end of R19 closest to the board edge connector.

Step 4. Adjust R75 for 2.121 V rms (±10 mV rms).

3.4.4 NBFM Audio Set (R77)

Step 1. Set service monitor AM/CW/FM switch to FM, FUNCTION switch to SENS MON, BW switch to NAR, and SQUELCH control fully counterclockwise. Remove phono plug from receiver board.

Step 2. Apply a 10.7 MHz signal at a level of −47 dBm (1000 uV) frequency modulated ±5.0 kHz with a 1000 Hz tone to the phono jack on the receiver board.

Step 3. Connect an ac voltmeter to the end of R19 closest to the board edge connector. Adjust R77 for 354 mV rms (±4 mV rms).

3.5 LOW VOLTAGE POWER SUPPLY (RTP4018B) ADJUSTMENT PROCEDURE

3.5.1 Setup Procedure

NOTE

With service monitor off, remove power supply and reinstall using an extender card and cable.

Step 1. Preset R53 and R62 fully clockwise, R61 fully counterclockwise, and R60 to midposition.

Step 2. Turn service monitor to STBY.

3.5.2 Oscillator Frequency Adjustment

Step 1. Adjust R57 for a triangular wave with a period of 7.7 uSec (±0.2 uSec) at pin 3 of U4 as viewed on an oscilloscope (refer to schematic diagram and circuit board detail in Low Voltage Power Supply section (68P81064E51) of this manual).

Step 2. Set service monitor to OFF, then back to STBY.

3.5.3 Overvoltage Adjustment

Step 1. Adjust R60 to 5.6 V at pin 8 or pin 10 of the edge connector. Note R60 position.

Step 2. Adjust R62 until the voltage at pin 8 or pin 10 is 0 V and the supply is shut off.

Step 3. Adjust R60 to midposition.

Step 4. Switch service monitor to OFF, then back to STBY.

3.5.4 Undervoltage Adjustment

Step 1. Adjust R60 to give 4.6 V dc at pin 8 or pin 10. Note R60 position.

Step 2. Adjust R61 until the voltage goes over 0 V dc.

3.5.5 Output Voltage Adjustment

Step 1. Adjust R60 midway between the positions noted in Step 1 of the Overvoltage Adjustment and Step 1 of the Undervoltage Adjustment.

Step 2. Switch service monitor to OFF, then back to STBY.

Step 3. Adjust R60 to 5.1 V dc (±20 mV) at pin 8 or pin 10.

3.5.6 Float Voltage Adjustment

NOTE

Perform this adjustment ***only*** if the optional battery is installed.

Step 1. Turn service monitor to OFF.

Step 2. Remove top cover of service monitor. Disconnect the red lead from battery.

Step 3. Turn service monitor to ON.

Step 4. Adjust R30 for 13.8 V dc (±100 mV) measured at the red lead.

Step 5. Turn service monitor to OFF. Reconnect the battery lead and replace cover.

3.5.4 Undervoltage Adjustment

Step 1. Adjust R60 to give 4.6 V dc at pin 8 or pin 10. Note R60 position.

Step 2. Adjust R61 until the voltage goes over 0 V dc.

3.5.5 Output Voltage Adjustment

Step 1. Adjust R60 midway between the positions noted in Step 1 of the Overvoltage Adjustment and Step 1 of the Undervoltage Adjustment.

Step 2. Switch service monitor to OFF, then back to STBY.

Step 3. Adjust R60 to 5.1 V dc (±20 mV) at pin 8 or pin 10.

3.5.6 Float Voltage Adjustment

NOTE

Perform this adjustment ***only*** if the optional battery is installed.

Step 1. Turn service monitor to OFF.

Step 2. Remove top cover of service monitor. Disconnect the red lead from battery.

Step 3. Turn service monitor to ON.

Step 4. Adjust R30 for 13.8 V dc (±100 mV) measured at the red lead.

Step 5. Turn service monitor to OFF. Reconnect the battery lead and replace cover.

3.6 ANALOG INTERFACE BOARD (RTL4092B) ADJUSTMENT PROCEDURE

Switch service monitor to OFF. Remove top cover. Place analog interface board on extender card. Switch service monitor to ON.

3.6.1 U2 Null (R12)

Step 1. Set service monitor for DVM, DC volts.

Step 2. Measure voltage at U2-pin 6 (card edge pin 1 as ground) with a dc voltmeter. With no input to VERT/SINAD/DIST/DVM IN jack, adjust R12 for 0 V dc (±0.6 mV).

3.6.2 U7 Null (R8)

Adjust R8 for .000 on display.

3.6.3 AC Accuracy

Step 1. Adjust R24 to midposition and select DVM, AC volts.

Step 2. Apply a 10 mV rms ac (±0.5 mV) signal at a frequency of 1 kHz to VERT/SINAD/DIST/DVM IN jack. Adjust R30 for .010 on display.

Step 3. Apply a .997 V rms (±1 mV) 1 kHz signal to VERT/SINAD/DIST/DVM IN jack. Adjust R24 for .997 on display.

3.6.4 AC Attenuation Compensation

Step 1. Apply a 5.55 V rms (±50 mV) signal at a frequency of 10 kHz to VERT/SINAD/DIST/DVM IN jack. Adjust C2 so display reads 5.55.

Step 2. Switch service monitor to OFF. Insert board without an extender card.

Step 3. Switch service monitor to ON. Note reading on display. If reading is higher than 5.55, determine the difference. C2 must be adjusted ***on extender card*** to (5.55 minus the difference).

Step 4. If the reading in Step 3 is lower than 5.5, determine the difference. C2 must be adjusted ***on extender card*** to (5.55 plus the difference).

3.6.5 1 kHz Notch Adjustment

Step 1. Set service monitor for DMV, AC volts. Apply a 0.900 V rms (±50 mV) signal at a frequency of 1001 Hz (±0.25 Hz) to VERT/SINAD/DIST/DVM IN jack.

Step 2. Using an ac voltmeter at U3 pin 1, adjust R101 for a minimum on voltmeter.

Step 3. Change generator frequency to 999 Hz (±0.25 Hz).

Step 4. Using an ac voltmeter at U3 pin 14, adjust R119 for a minimum on voltmeter.

3.6.6 Peak Detector Adjustment

NOTE

Before proceeding with the following procedure, ensure that the receiver adjustment and alignment have been performed.

Step 1. Set service monitor AM/CW/FM switch to FM, FUNCTION switch to SENS MON, BW switch to NAR, and SQUELCH control fully counterclockwise, DEV/%AM, and STEP attenuator to 0 dB. Program for 11.0000 MHz.

Step 2. Apply a 11.0000 MHz signal at a level of −47 dBm (1000 uV) frequency.

Step 3. Select +DEV. Adjust R55 for 5.0 on display.

Step 4. Select −DEV. Adjust R62 for −5.0 on display.

3.7 COUNTER BOARD (RTL4106A) ADJUSTMENT PROCEDURE

3.7.1 A/D Converter Adjustment

Step 1. Switch service monitor to OFF. Place counter board on extender card. Switch service monitor to ON. Connect a dc voltmeter to reference integrated circuit U27. Adjust R40 for 2.490 V dc (±.01 V) on voltmeter.

NOTE

The rest of the counter board adjustment *must* be preceded by the analog interface adjustment (paragraph 3.6).

Step 2. Set service monitor for DVM, DC volts.

Step 3. Apply 10 mV dc (±0.5 mV) to VERT/SINAD/DIST/DVM IN jack.

Step 4. Adjust R17 until display reads .010.

Step 5. Apply 990 mV dc (±0.5 mV) to VERT/SINAD/DIST/DVM IN jack.

Step 6. Adjust R21 until the display reads .990. Repeat Steps 3 through 6 until no further adjustment of R17 and R21 is required.

3.7.2 AM Adjustment

Step 1. Set service monitor FUNCTION switch for HI GEN, AM/CW/FM switch to CW, and all modulation sources off. Program for 10.0000 MHz. Connect an oscilloscope to ANTENNA jack (greater than 10 MHz bandwidth).

Step 2. Adjust RF VERNIER control and STEP attenuator for 1 V p-p on oscilloscope.

Step 3. Set AM/CW/FM switch to AM. Adjust R42 for 0.5 V p-p on oscilloscope.

3.7.3 PLL Adjustment

Step 1. Remove receiver board. Unsolder and lift one end of C65 on receiver board and reinsert receiver board. Set SQUELCH control fully CCW.

Step 2. Adjust R102 until FREQuency ERRor display reads 0 ±10 kHz. Reconnect receiver capacitor.

3.8 FRONT PANEL INTERFACE (RTL4100A) ADJUSTMENT PROCEDURE

3.8.1 V_{ref} Adjustment

Step 1. Turn service monitor to OFF. Place front panel interface (FPI) board on an extender card. Switch service monitor to ON.

Step 2. Adjust R80 until the voltage at J1 pin 9 is +7.00 V dc (±.01 V).

3.8.2 Internal Source Offset Adjustment

Step 1. Set scope SOURCE switch to MOD, and FUNCTION switch to SENS MON.

Step 2. Ground U18, pin 14. Adjust R66 until the voltage at U19, pin 6 is 0 V (±1 mV). Remove ground from U18, pin 14.

3.8.3 DC Balance Adjustment

Turn service monitor to OFF. Place scope amplifier board on extender card. Switch service monitor to ON. Use dc voltmeter and measure U14-1 on scope amplifier board. Adjust R9 on the FPI until the voltage at U14-8 on the scope amplifier board equals that measured at U14-1 on the scope amplifier board.

3.8.4 Scope Attenuator Compensation

Step 1. Set service monitor SOURCE switch to EXT VERT AC, and HORIZ switch to 100 mV/div.

Step 2. Apply a 1 kHz square wave at a level of 0.6 V p-p to VERT/SINAD/DIST/DVM IN jack.

Step 3. Adjust C76 for best square wave on CRT.

3.8.5 Scope Input Compensation

Step 1. Using a ×10 oscilloscope probe connected to VERT/SINAD/DIST/DVM IN jack, connect probe to the output of a function generator at approximately 100 kHz and 0.2 V rms.

Step 2. Set service monitor to DVM, AC volts and set SOURCE switch to EXT VERT AC.

Step 3. Adjust generator output until display reads .200 (±1 mV).

Step 4. Change SOURCE switch to MOD. Adjust C66 until DVM returns to 0.200 (±1 mV).

3.9 WIDEBAND AMPLIFIER BOARD (RTL4093A) ADJUSTMENT PROCEDURE

3.9.1 High and Lo Generator Calibration

Step 1. Set Offset (R276) and Gain (R252) potentiometers on the wideband amplifier board to midposition.

Step 2. Connect an rf signal generator to J4 (rf synthesizer injection input port). Adjust generator output for a frequency of 500 MHz at a −10 dBm (approximately 70.7 mV) level.

Step 3. Disconnect the hardline coaxial cable from J3 (generator output port).

NOTE

Ensure that adequate attenuation is in line with the spectrum analyzer in order to avoid overload and prevent spurious signals from being generated before proceeding with the next step.

Step 4. Connect the spectrum analyzer to J3. (The maximum output of J3 is +13 dBm (1 V). Adjust the spectrum analyzer to view 0-1000 MHz full scale horizontal and 0 dBm (224 mV) full scale vertical.

Step 5. Set service monitor FUNCTION switch to GEN and AM/CW/FM switch to CW. Adjust RF VERNIER control for an rf output level of −34 dBm (±0.5 dB) (4.46 mV ±0.25 mV).

Step 6. Connect DMM (dc) to CAR & MOD LEVEL OUT (J200-15). Adjust the Gain potentiometer (R252) for 4.75 V dc (±.01 V dc) on the DMM.

Step 7. Repeat the RF VERNIER adjustment (Step 5) and Gain potentiometer (R252) adjustment (Step 6) until the correct rf output level (−34 dBm ± 0.5 dB) and dc voltage (4.75 V dc ±.01 V) are obtained.

NOTE

The amplitude modulation calibration must be performed after the High and Lo generator calibration.

3.9.2 Amplitude Modulation Calibration

Step 1. Connect the rf signal generator to J4 (rf synthesizer injection input port).

Step 2. Disconnect the hardline coaxial cable from J3 (generator output port).

Step 3. Connect the spectrum analyzer to J3.

Step 4. Set service monitor FUNCTION switch for GEN, IMAGE switch to HI, AM/CW/FM switch to CW, and connect DMM to CAR & MOD LEVEL OUT (J200-15). Adjust RF VERNIER control for an rf output level of −45 dBm (±0.5 dB). (1.26 mV ±.08 mV).

Step 5. Set AM/CW/FM switch to AM (without modulation). Adjust R42 (AM adjust) on counter board for −49 dBm (±0.5 dB) (793 uV ±44 uV) on spectrum analyzer.

Step 6. Adjust the RF VERNIER control for 0.590 V dc (±.005 V) on DMM (J220-15).

Step 7. Remove the spectrum analyzer from J3 (generator output port). Connect the 0.1-1300 MHz, 48 dB gain amplifier and modulation analyzer to J3 (generator output port).

Step 8. Connect an ac voltmeter to J200-15 CAR & MOD LEVEL OUT. Turn on the 1 kHz modulation source and adjust for 0.137 V rms (±.005 V) on the ac voltmeter.

Step 9. Adjust the Offset potentiometer (R276) for 50 ±2% AM on the modulation analyzer.

Step 10. Repeat the adjustments in Step 8 and Step 9 until the correct audio output level 0.137 V rms ±.005 V) and 50 ±2% modulation are obtained.

Step 11. Remove the 0.1-1300 MHz 48 dB gain amplifier and modulation analyzer from J3 (generator output port).

Step 12. Connect the hardline coaxial cable to J3.

3.9.3 Sensitive Monitor (Receive) 10.7 MHz I-F Alignment and Sensitivity Tests

Step 1. Remove hardline coaxial cable from J3 and coaxial cable from J4. Connect the first rf signal generator to J4 (rf synthesizer injection input port). Inject a −10 dBm, 110.7 MHz signal into this port.

Step 2. Connect the second rf signal generator to J6 (rf input port). Inject a −20 dBm (22.4 mV), 100 MHz signal into this port.

Step 3. Remove coaxial cable from J5. Connect the spectrum analyzer to J5 (10.7 MHz i-f).

Step 4. Set service monitor FUNCTION switch to SENS MON, and STEP attenuator to 0 dB.

Step 5. Alternately adjust the i-f amplifier coil (L212) and capacitor (C232) for maximum output at 10.7 MHz as viewed on the spectrum analyzer. After peaking both the coil and capacitor, the 10.7 MHz i-f output level must be 0 dBm (±2 dB) (223 mV ±58 mV).

3.10 WATTMETER (RTL4094A) CALIBRATION PROCEDURE

The wattmeter must be re-calibrated whenever any components are replaced or adjustments are made to the module. It is not practical to program a new PROM using field equipment. Therefore, calibration at the time of manufacture is likely to be invalid when components are changed. The complete module must be returned to a factory service center for certified calibration.

NOTE

The following alignment procedure assumes that calibrated laboratory standards are used to produce a known, accurate rf power source at the specified frequency and power levels.

3.10.1 Calibration Procedure

Step 1. Connect test equipment and service monitor as shown in Figure 2. Leave the rf module installed in the service monitor.

Step 2. Use the sample calibration chart provided below to prepare a calibration guide for the rf millivoltmeter at various power levels.

Sample Calibration Chart

Data Point	True Power	Equiv. Voltage
P20		
P5		
P2		
P0.5		

Step 3. Connect the HP436A 25 watt power meter directly (no coaxial cable) to the output of the directional coupler.

Step 4. With points A-B connected directly together, turn on the rf power source and record the true power reading on the HP436A meter and the equivalent rf voltage on the rf millivoltmeter as data point P20.

NOTE

Do not key the power source longer than necessary to minimize overheating the power attenuators. Excessive heat can change attenuator accuracy.

Step 5. Connect the NARDA 755 6 dB attenuator to points A-B. Turn on the rf power source and record true power and equivalent power for data point P5.

Step 6. Connect the NARDA 766 10 dB attenuator to points A-B and repeat the power readings for data point P2.

Step 7. Connect both the 10 dB and 6 dB attenuators in series as shown in Figure 2 and record the power readings for data point P0.5.

NOTE

This procedure produces an indication of true forward power into an unknown load, independent of the VSWR of the load or how the load may affect the ability of the rf power source to produce a required power.

Step 8. Plot the data in the sample calibration chart using 2-cycle, semilog graph paper such as shown in Figure 3. The voltage is plotted along the vertical scale and the true power along the horizontal scale. Draw a smooth curve through these points.

Step 9. Connect the 6 dB attenuator between points A-B, and connect the output of the directional coupler directly to the RF IN/OUT jack.

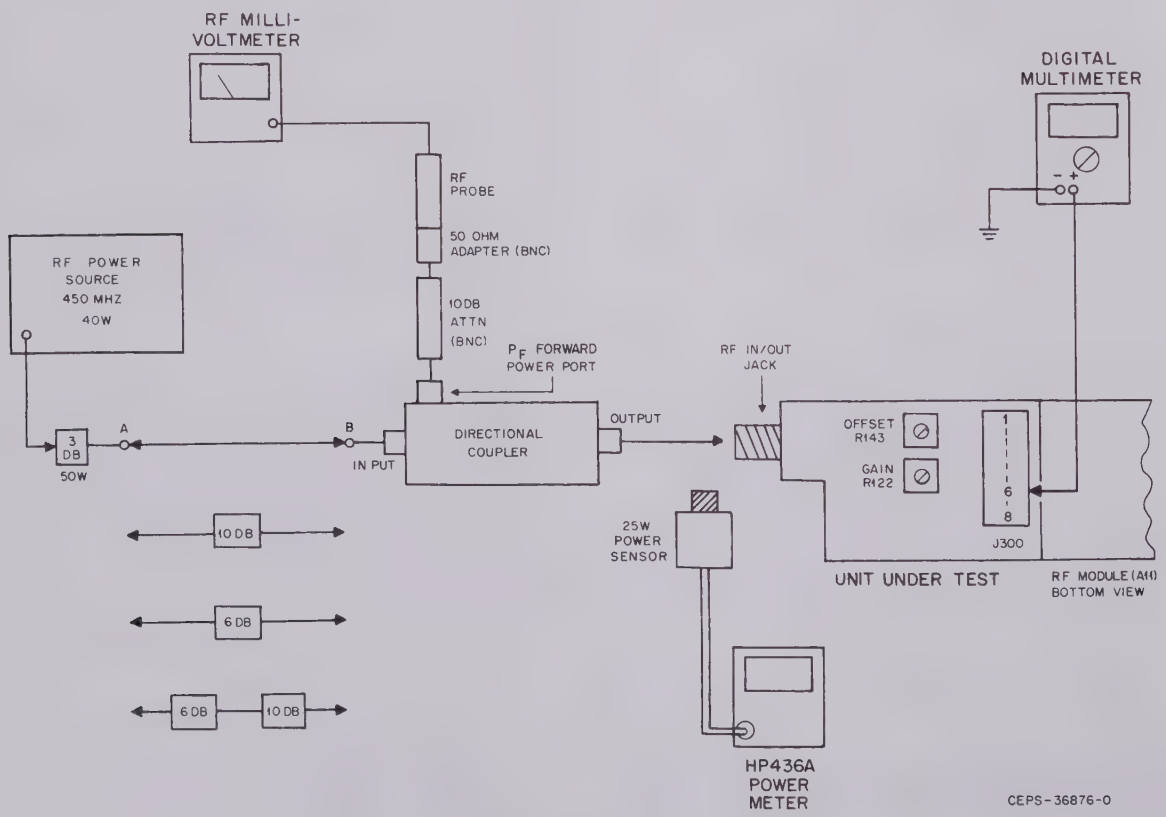


Figure 2. Wattmeter Calibration Test Set-up

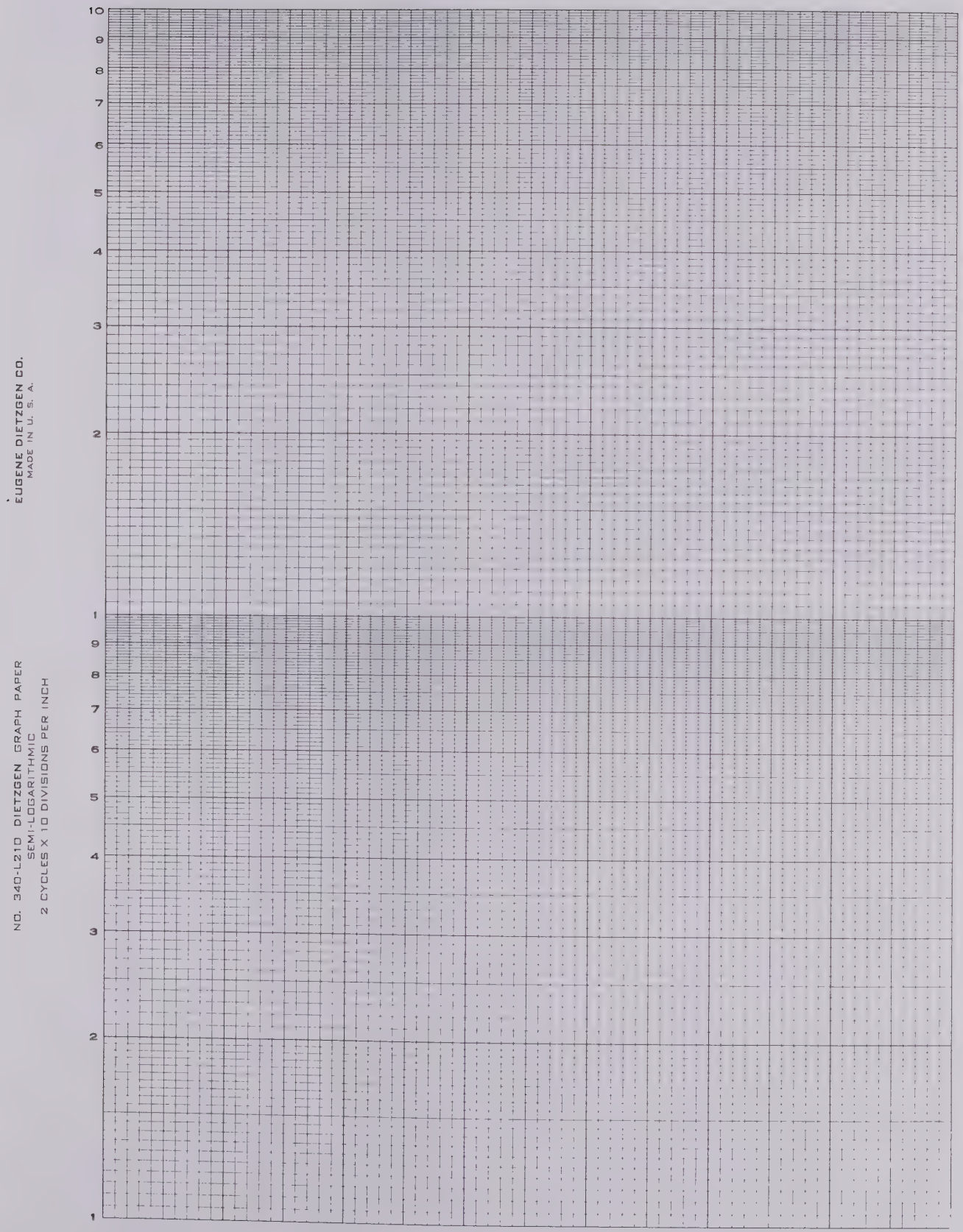


Figure 3.
2-Cycle Semilog Graph Paper for Calibration Chart

Step 10. With the rf power source fully off, turn on the service monitor. Set the FUNCTION switch to PWR MON. Enter the actual test frequency of the rf power source at the front panel keyboard.

Step 11. Turn Offset potentiometer R143 to the mid-point and then clockwise until the LCD displays 0.01 watts. Turn R143 counterclockwise just until 0.00 is displayed. Use the DVM to measure the voltage at J300-6. This should be +0.47 ±0.1 V dc.

Step 12. Turn on the rf power source and observe the equivalent rf voltage reading on the millivoltmeter. Locate this voltage on the graph to determine the true power output.

Step 13. Adjust the rf power source (if adjustable) until the true power is 5.0 watts (±0.05 watts). The voltage at J300-6 should be +1.5 V dc (±0.05 V dc).

Step 14. Adjust the Gain control (R122) until the true power is displayed on the LCD.

Step 15. Repeat Steps 9 through 14 until the true power is refined and further adjustments are not necessary.

Step 16. Connect the 10 dB and 6 dB attenuator in series as shown in Figure 2.

Step 17. Key the rf power source and observe the rf equivalent voltage on the millivoltmeter. Using the graph, determine the true power (P0.5) and compare it to the power displayed. The power displayed should be within 10% of the graphed true power.

Step 18. If the true power is not within 10%, adjust the Gain potentiometer (R122) to increase or decrease the displayed power accordingly. Recheck the (P5) measurement.

Step 19. Connect the 10 dB attenuator as shown in Figure 2 and measure the true power and equivalent voltage recorded in P2. Refine the R122 adjustment if necessary.

Step 20. Remove the attenuators and connect points A-B directly together. Measure the true power and equivalent voltage and verify it is the same as that recorded earlier at P20.

NOTE

Minor adjustment of R122 and R143 may be required to obtain the ten percent accuracy at each power level.

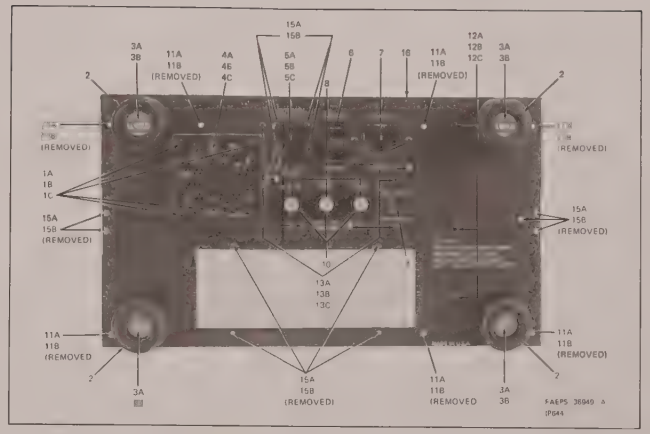
IMPORTANT

As a final caution, it should be noted that this calibration procedure does not constitute a traceable accuracy to any standard. Therefore, power measurements of transmitters cannot be certified to the user or operator of such transmitters.

parts list

Rear Panel Mechanical Parts List PL-8589 A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
1A	3-80312B02	SCREW: 4-40 × 1-1/8"; 4 used
1B	4-140208	WASHER; split; 4 used
1C	43-80390A34	SPACER; 4 used
2	75-80378A91	FOOT; rubber, 4 used
3A	3-490642	SCREW: 10-32 × 1-1/2"; 4 used
3B	2-115123	NUT: 10-32 lock; 4 used
4A	13-80390A35	GRILLE
4B	35-80397A71	SCREEN
4C	1-80351A17	FAN ASSEMBLY
5A	15-10811A07	HOUSING, plug: 4-contact
5B	38-8029408	CAP, sealing connector
5C	39-80397A84	CONTACTS; 2 used
6	40-80390A50	SWITCH; rocker (S13)
7	9-82393K02	CONNECTOR, AC
8	9-80312B40	FUSEHOLDER; 3 used
9	40-80312B41	SWITCH; voltage selector (S14)
10	43-80312B56	SPACER; 3 used
11A	3-80335A97	SCREW, 6-32 × 5/16" Phillips; 7 used
11B	4-140209	WASHER; #6 split; 7 used
12A	3-80335A97	SCREW, 6-32 × .3; 3 used
12B	4-140209	WASHER, #6 split; 3 used
12C	2-132516	NUT, 6-32 hex locks; 3 used
13A	3-80395A09	SCREW, 4-40 x 3/8"; 10 used
13B	2-131435	NUT; 4-40 hex lock: 10 used
13C	4-140208	WASHER, #4 split; 10 used
15A	3-80395A09	SCREW; 4-40 × 3/8"; 13 used
15B	4-140208	WASHER; #4 split; 13 used
16	1-80351A41	REAR PANEL ASSEMBLY; complete
		non-referenced items
	1 80351A47	CABLE
	4-7607	WASHER FLAT
	6-80395A72	VARISTOR, 275 volt
	25-80312B60	TRANSFORMER (T3)
	26-80312B63	SHIELD
	14-80312B64	INSULATOR
	29-5248	SOLDER LUG
	42-82143C01	CABLE CLAMP
	76-80312B75	FERRITE BEAD (E9, E10, E11)
	91-80312B54	POWER LINE FILTER (FL1)
	64-80312B65	PANEL, plate, rear
	65-20404	FUSE: 3 amp; 250 V (F3)
	65-474899	FUSE: 1/8 amp; 250 V (F4 used in 115 V ac operation)
	65-80397A22	FUSE, 6 amp, 32 V (F2)
	65-81668	FUSE: 1/10 amp, 250 V (F4 used in 220 V ac operation



FUNCTION

The rear panel contains the power line filter, system cooling fan, fuses, 110-220 V ac switch and the EXT DC/BATTERY switch. From the ac line switch, ac power is routed through the ac line filter to the auxiliary power transformer. The EXT DC/BATTERY switch selects either the internal battery (optionally supplied) or an external dc source which are both routed through the dc fuse.

MOTOROLA INC.
Communications
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LOW VOLTAGE POWER SUPPLY

MODEL RTP4018B

1. DESCRIPTION

1.1 The low voltage power supply (LVPS) provides all of the dc voltages necessary to power the service monitor. The unit operates with an input of 90-130 or 180-260 V ac, 50-60 Hz, or 11-17 V dc. An internal battery pack allows the unit to be used without external voltages.

1.2 When the unit is plugged into the ac line, operation is automatically switched to the ac voltage. A battery charger is included on the power supply board. A standby mode allows the removal of power from the other modules in the service monitor except for the OCXO/TCXO and the battery charger.

2. THEORY OF OPERATION

2.1 When operating from ac line voltage, low voltage ac from T3 is applied across pins 2 and 8 of the 9-pin connector, rectified by bridge rectifier CR45 and filter C18. This voltage is sensed by Q16 which turns off the dc latch and energizes K2. When K2 opens, the dc path is interrupted and high voltage dc is sent to the ac switching transistors. This also turns on Q14 and energizes K1. K1 turns on Q27 and completes the high voltage dc circuit.

2.2 The voltage on C18 is also connected to Q17, the 12-volt regulator. U3B compares a reference voltage developed by VR6 and R110 with a portion of the output, and controls the base voltage to Q17 to maintain 12 volts at the collector of Q17. Transistor Q19 is connected through R43 to the ON/OFF switch. The power supply is turned off by turning off the 12 volt regulator. If the external ac voltage is too high, VR7 conducts and turns on Q19. This then turns off the power supply, and keeps Q27 off.

2.3 When 220 V ac is used to power the service monitor, pins 4 and 7 of the 9-pin connector supply the voltage to bridge rectifier CR44. Filtering by C1 and C2 provides high voltage dc. If the power supply is operated from 110 V ac, the power is applied to pins 1 and 4; and CR44, C1, and C2 act as a voltage doubler. Selection of either 110 or 220 V ac is done on the back panel. VR10 and VR11 protect against voltage surges. R1 and R2 are bleeder resistors.

2.4 The bases of Q5 and Q6 are driven alternately by rectangular pulses of 65 kHz from U4. The width of these pulses are varied to provide regulation. This waveform is coupled by transformer T1 to drive high voltage switching transistors Q1 and Q2. The transistors drive current first into and then out of the high voltage primary DM pins 5 and 6 of the switching transformer. It is important that there is dead time when both Q1 and Q2 are off or there will be a short circuit across the high voltage circuit. The RC circuit of R5 and C7 is a snubber circuit to damp out oscillations when both Q1 and Q2 are off. C3 is used to eliminate any dc component of voltage through T2 which would tend to cause T2 to saturate.

2.5 The output of the secondary windings of the switching transformer are full wave rectified and filtered by LC filters. The 12-volt output (via CR23) provides drive current as soon as the 12-volt output is greater than the regulated 12-volts which supplies a drive circuit power through CR22. The +5-volt output is fed back to three potentiometers that control overvoltage and undervoltage protection and the 5-volt adjustment. The voltage at R60 is sensed by U3A and compared with a reference voltage (about 2.3 volts) from U4-10. R54, R55, C31, C32, and C33 form a compensation network to provide stability and high gain.

2.6 The error signal from U3A-1 is connected to U4-4, and controls the width of the pulses at U4A-12 and U4A-13. R57 and C26 control the switching frequency. R62 is adjusted to provide overvoltage protection. When the voltage at U4-7 rises above the reference voltage on U4-10, the power supply is shut down. R61 adjusts the undervoltage protection. When the voltage at U4-6 drops below the reference voltage the supply is shutdown. Overcurrent, 5-volt overvoltage or undervoltage fault detection causes the supply to shut down and latch off.

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4/1/84-PHI
68P81064E51-B

2.7 Because the LVPS cannot instantly provide 5 volts at the output, Q20 turns on initially for about one second until the output has time to come up to full power. Thus, there is a voltage at pin 6 and the under-voltage protection is bypassed during turn on.

2.8 Capacitor C27 is charged by a source internal to U4 and provides a soft-start. This allows the power supply to start up slowly over about one-half second to avoid large initial current surges.

2.9 DC power is supplied to U4 through Q25 to pin 11. Q25 and Q26 form a switch that is controlled by the ON/OFF switch. When the unit is in standby, relay K3 is open. Turning the service monitor on turns on Q21 which in turn pulls the base of Q26 low. This turns Q25 off which turns off the supply. The output filter capacitors discharge through the bleeder resistors. C36 begins charging through R66, and after about 2 seconds, Q22 turns on and K3 is closed. This turns off Q21. This action permits the power supply to turn on again under soft-start control. Closing K3 with the supply off avoids large surge currents through K3 contacts as the supply tries to instantly charge up all the discharged bypass capacitors on the other modules.

2.10 VR7 and Q19 shut down the power supply if the ac line voltage is higher than 132 volts at turn on, or if the voltage rises to 140 volts after being turned on.

2.11 R33, R34, and C7 insure that the ac input drivers and the dc input drivers cannot be on at the same time. If the service monitor is operating from a dc source and is then plugged into an ac line without the unit being turned off, the service monitor shuts down. To resume operation, the service monitor must be turned off and then back on in order to reset the protective circuits. The same procedure applies when going from ac to dc.

2.12 When operating from external dc or internal battery, relays K1 and K2 are in the normal position with the high voltage circuit open. Transistors Q3 and Q4 are operated as a push-pull circuit to drive the low voltage primary of the switching transformer.

2.13 Output and feedback circuits are the same as in ac operation. The power to the 12-volt regulator is now supplied through CR25 from the dc latch circuit. This circuit is started when Q9 is turned on momentarily as C13 charges through the ON/OFF switch. Q8 is turned on and Q7 saturates, turning on the latch. As long as the input voltage is above about 11 volts, VR3 conducts and the latch is kept on. If the voltage drops below this, VR3 stops conducting and the latch is turned off removing all current drain from the battery. If the input rises above 18 volts, VR4 conducts and Q10 turns on. This shuts down the latch to protect the supply.

2.14 Transistors Q23 and Q24 provide gate drive to power FET's Q3 and Q4. The resistors and diodes on the gates provide shaped drive to minimize ringing. VR1 and VR2 are there to insure that the drain-source breakdown voltage is never exceeded. L1, C9, and C10 filter the large current pulses on pin 2 of T2 from the battery input or external dc input lines.

2.15 The battery charger is a temperature compensated dual rate current limited charger. The charger operates whenever the unit is in ac operation, either ON or in STBY. Pin 4 of U1 provides a reference voltage of 7.2 V $\pm$0.2 volts that is divided by R16, R17, R30, and CR11, and is amplified by U2 to provide a temperature compensated reference voltage to U1.

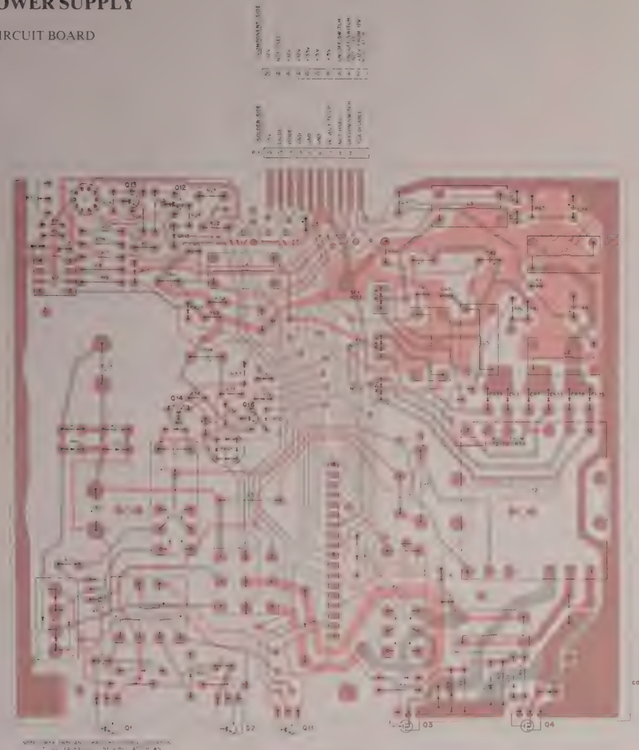
2.16 Diode CR11 has temperature characteristics that track those of the battery. R30 is used to set the battery charge voltage to 13.7 $\pm$50 mV with the battery disconnected from the charger. U1 and Q11 form a series pass regulator that is current limited by sense resistor R23. As the charging current drops below 1.2A, U1 comes out of current limit. As long as the charge current is greater than about 700 mA, Q12 remains on due to the voltage drop across R22 and R23. This keeps Q13 on which sets the charge voltage at 14.7 volts by placing R28 in parallel with R29 of the output voltage divider. As the charge current decreases to less than about 700 mA, Q12 and Q13 are cutoff and the charge voltage is at 13.7 volts. Pin 9 of U1 is the enable control. When the power supply is operated from a dc input, pin 9 is pulled low which then turns the battery charger off.

2.17 An over temperature shutdown relay is located on the main interconnect board. At 75°C $\pm$5° the relay opens causing the supply to shut down.

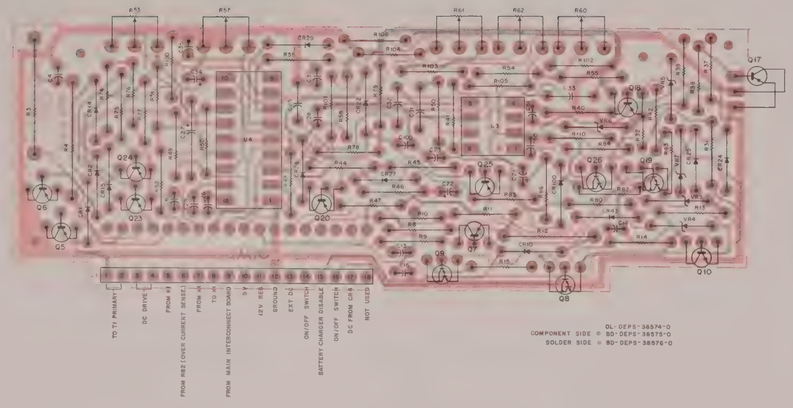
2.18 The rear panel contains T3, the ac line filter, dc input fuse, ac input power module, fan, battery/external dc select switch, and external dc input connector.

LOW VOLTAGE POWER SUPPLY

MODEL RTP4018B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



SHOWN FROM SOLDER SIDE



SHOWN FROM COMPONENT SIDE

SOLDER SIDE = 80-EEPS-38578-0
COMPONENT SIDE = 80-EEPS-38575-0
OL-EEPS-38577-0

OL-EEPS-38574-0
COMPONENT SIDE = 80-EEPS-38575-0
SOLDER SIDE = 80-EEPS-38576-0

Motorola No. PLPS-36840-B
(Sheet 1 of 2)
3-82 (4-91)

parts list

RTP4018B Low Voltage Power Supply — PL 6471-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF = 80 – 20%; 50 V; unless otherwise stated
C1, 2	23-80385A80	220 ± 20%, 250 V
C3	21-80378A15	0.47 ± 10%, 400 V
C4	21-84008H03	0.15
C5, 6	23-80390A76	10 ± 20%
C7	21-82187B01	.0022 ± 20%, 3000 V
C8, 9	21-84008H03	0.15
C10	8-80395A76	6 ± 10%; 35 V
C11, 12, 13	21-84008H03	0.15
C14	21-84008H08	.02 ± 20%
C15	23-80390A76	10 uF ± 10%
C16	21-84008H03	0.15
C17	23-80390A76	10 ± 20%
C18	23-80390A64	1000 ± 20%
C21, 22	23-80390A76	10 ± 20%
C23	21-84008H03	.15
C25	21-84494B12	220 pF ± 5%, 500 V
C26	21-80397A12	820 pF ± 5%, NPO
C27	23-84762H14	0.47 ± 20%
C28	21-84008H03	0.15
C29	21-84008H21	0.15 ± 20%
C30	21-84008H03	0.15
C31	8-84631L30	.0022 ± 10; 630 V
C32	21-84494B85	140 pF ± 3%, 500 V
C33	8-84631L28	.018 ± 10%; 250 V
C34	23-80390A76	10 ± 20%; 50 V
C35	21-84008H03	0.15
C36	21-84494F14	220 - 150 pF, 10% 16 V
C37	21-84008H03	0.15
C38, 39	23-80390A61	330 ± 20%
C40, 41	21-84008H03	0.15
C42	23-80390A61	330 ± 20%
C43	21-84008H03	0.15
C44	23-80390A61	330 ± 20%
C45	21-84008H03	0.15
C46	23-80390A62	100 ± 20%
C47	21-84008H03	0.15
C48	23-80390A62	100 ± 20%
C49	21-84008H03	0.15
C50, 51	21-84008H16	.01 ± 5%
C100	21-84008H03	0.15
		diode: (see note)
CR1, 2	48-83654H01	silicon
CR3, 4	48-82468H18	silicon
CR5, 6	48-80390A74	silicon
CR7	48-82525G20	silicon
CR10	48-83654H01	silicon
CR17	48-83654H01	silicon
CR18	48-82184A11	silicon
CR14, 15	48-83654H01	silicon
CR17, 18	48-83654H01	silicon
CR19	48-83654H02	silicon
CR20, 21	48-82468H01	silicon
CR22, 23, 24	48-82468H01	silicon
CR25	48-82525G23	silicon
CR27, 28, 29	48-83654H01	silicon
CR33	48-82525G20	fast recovery
CR34	48-80395A79	hi voltage fast recovery
CR35	48-80390A73	fast recovery
CR36	48-80390A67	dual schottky
CR38	48-80390A73	fast recovery
CR39	48-80390A70	fast recovery
CR40	48-80390A56	dual fast recovery
CR42	48-80390A70	fast recovery
CR43	48-82468H01	silicon
CR44	48-80390A89	bridge rectifier
CR45	48-84621E08	bridge rectifier; 400 V
CR100, 101, 102	48-83654H01	silicon
		connector, receptacle:
J1	9-80397A55	female, 18-contact
J2	28-80390A09	male; 9-contact
P1	28-80897A54	male; 18-contact
		filter:
FL1	91-80312B54	line
		relay:
K1, 2	80-80378A39	dpdt; coil res. 265 ohms
		coil, rf:
L1	24-80395A61	toroid, 17 uH
L2	24-80395A84	toroid, 1.5 mH
L3	24-80395A85	toroid, 2.8 mH
L4	24-80395A53	toroid, 350 uH
L5	24-80395A63	toroid, 350 uH
L6	24-80395A62	toroid, 350 uH
L7	24-80395A63	toroid, 350 uH
		thermistor:
RT1	8-80395A72	thermistor

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		transistor: (see note)
Q1, 2	48-80390A65	NPN, type M9A80
Q3, 4	48-80390A66	field-effect
Q5, 6, 7	48-869649	PNP, type M9649
Q8	48-869706	Darlington, type M9756
Q9	48-869707	PNP, type M9707
Q10	48-869648	NPN, type M9648
Q11	48-869806	NPN, type M9806
Q12	48-869649	PNP, type M9649
Q13	48-869648	NPN, type M9648
Q14	48-869706	Darlington, type M9706
Q15	48-869648	NPN, type M9648
Q17	48-869807	PNP, type M9807
Q18	48-869649	PNP, type M9649
Q19	48-869706	Darlington, type M9706
Q20	48-869649	PNP, type M9649
Q21	48-869706	Darlington, type M9706
Q22	48-869648	NPN, type M9648
Q23, 24	48-869713	PNP, type M9713
Q25	48-869649	PNP, type M9649
Q26	48-869706	Darlington, type M9706
Q27	48-80312B53	Triac
		resistor, fixed: ± 5%; 1/4 W; unless otherwise stated
R1, 2	6-126A89	47k, 1 W
R3, 4	17-80363G28	100, 2 W
R5	17-82036G06	2.7 ± 10%; 2 W
R6 *	6-11009C15	270
R8	6-11041D36	820k, 1/8 W
R9	6-3248Bx	1.8 meg
R10	6-11041D34	680k, 1/8 W
R11	6-11041C83	15k, 1/8 W
R12	6-125A35	270, 1/2 W
R13	6-11009C49	1k
R14	6-11041D07	22k, 1/8 W
R15	6-11041C87	8.2k, 1/8 W
R16	6-11009C75	13k
R17	6-10621B72	590 ± 1%
R18	6-10621C26	2.1k ± 1%
R19	6-10621C96	11.3k ± 1%
R20	6-11009E78	18k
R21	8-11009E55	1.8k
R22	17-82036G18	0.56 ohms
R23	17-82036G56	0.47 ohms
R24	6-11009E73	10k
R25	6-11009D18	560k
R26	6-11009C89	47k
R27	6-10621D53	45.3k ± 1%
R28	6-10621F15	205k ± 1%
R29	6-10621B53	267k ± 1%
R30	18-84527	variable, 5k
R31, 32	6-11009E47	1k
R33, 34	6-11009E41	22k
R35	6-11009E47	820
R36	6-11009E57	2.2k
R37	6-11041C99	27k, 1/8 W
R38	6-11009C39	390
R39	6-10621D05	13.7k ± 1%
R40	6-10621D10	15.4k ± 1%
R41	6-10621D05	13.7k ± 1%
R42	6-11041C89	10k, 1/8 W
R43	6-11009C79	3.9k, 1/8 W
R44	6-11009C32	200
R45	6-11009C41	470
R46	6-11041D13	91k, 1/8 W
R47	6-11041D39	82k, 1/8 W
R48	6-11041D25	300k, 1/8 W
R49, 50	6-11009C41	470
R51	6-11041C89	10k, 1/8 W
R52	6-11041C81	4.7k, 1/8 W
R53	18-83452F01	variable, 2k
R54	6-11041C92	13k, 1/8 W
R55	6-11041C75	2.7k, 1/8 W
R56	6-11041D15	110k, 1/8 W
R57	18-83452F17	variable, 50k
R58	6-11041D14	100k, 1/8 W
R59	6-11041C85	6.8k, 1/8 W
R60	18-83452F09	variable, 1k
R61, 62	18-83452F01	variable, 2k
R67, 68	6-11009E49	1k
R69	6-125A45	680, 1/2 W
R70	6-125A81	3.3k, 1/2 W
R71	6-126A57	2.2k, 1 W
R74, 75	6-11009E49	1k
R76, 77	6-11041C57	470, 1/8 W
R78, 79	6-11041C89	10k, 1/8 W
R80	6-11041D12	82k, 1/8 W
R81	17-82036G49	2k, 2 W
R82	8-11009E65	4.7k
R83	1041006	47k, 1/8 W
R84	6-11041C81	4.7k, 1/8 W
R85		NOT USED
R86	6-11041C81	4.7k, 1/8 W
R87	6-11041D06	47k, 1/8 W
R88 thru 99		NOT USED
R100	6-11041D65	1k, 1/8 W
R101	6-11041C71	1.8k, 1/8 W

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R102	6-11041C73	2k, 1/8 W
R103	6-11041C86	1.1k, 1/8 W
R104	6-11041C71	1.8k, 1/8 W
R105, 106	6-11041C86	1.5k, 1/8 W
R107, 108	6-11009C31	180
R109		NOT USED
R110	6-11041C71	1.8k, 1/8 W
R111	6-11009E18	51
		transformer:
T1	25-80390A53	base drive
T2	25-80390A54	switching
T3	25-80312B80	line
		integrated circuit: (see note)
U1	51-84320A52	voltage regulator
U2	51-82848M17	operational amplifier
U3	51-80365A07	dual operational amplifier
U4	51-80365A23	pulse width modulator
		voltage regulator:
VR1, 2	48-80395A74	Zener type; 56 V
VR3	48-83461E15	Zener type; 9.1 V
VR4	48-82256C63	Zener type; 17 V
VR5	48-83461E47	Zener type; 5 V
VR6	48-82256C61	Zener type; 5.8 V
VR7	48-83461E39	Zener type; 27.3 V
VR8, 9	48-82256C63	Zener type; 17 V
VR10, 11	48-80312B50	Zener type; 256 V
VR100	48-80797A71	Zener type; 7 V
		mechanical parts
	2-7019	NUT, 4-40 × 1/4 × 3/32"; 7 used
	2-13435	NUT, 4-40 × 1/4 × 3/32"; 2 used
	3-136785	SCREW, machine; 4-40 × 3/16"; 4 used
	3-139581	SCREW, machine; 4-40 × 3/16"; 8 used
	3-140207	SCREW, machine; 4-40 × 5/16"; 2 used
	3-80356A09	SCREW, pan head; 4-40 × 0.375"; 3 used
	4-114970	WASHER, flat; 0.125 × 0.250 × .020
	4-142208	WASHER lock #4 split; 8 used
	4-84180D01	WASHER shoulder; 7 used
	7-80377A38	BRACKET, mounting; 2 used
	7-80390A38	BRACKET
	14-80395A56	INSULATOR; 7 used
	14-80312B57	INSULATOR, mylar (bottom)
	14-80312B67	INSULATOR, nylon; 2 used
	14-80312B66	INSULATOR, transistor; 1 used
	26-80312B66	HEAT SINK
	42-83626D01	FASTENER; 4 used

note: For component performance characteristics and interchangeability, refer to the relevant Motorola program numbers.

MOTOROLA INC.
Communications
Sector

SCOPE MODULE

MODEL RTC1004B

1. DESCRIPTION

The scope module (RTC1004B) is comprised of the scope driver (RTC4021B), high voltage power supply (RTP4020B), and high voltage board (RTP4019B). The scope driver board amplifies the vertical and horizontal signals from the scope amplifier to the level necessary to drive the CRT deflection plates. CRT high voltages are developed by the high voltage power supply. The outputs are: −1200 V dc; 140 V dc; and 6.3 V ac. The inputs are +12 V dc, and +33 V dc, and an on/off control line called $\overline{HV}$ (high voltage disable). The scope high voltage board is an interface board which connects power, the grid blanking and deflection signals, and the astigmatism, trace rotation, FOCUS, and INTENSITY controls to the CRT.

2. THEORY OF OPERATION

2.1 SCOPE DRIVER BOARD

Three stages of amplification, the first two using differential amplifiers and current sources, and the third a class AB output, are used to boost the vertical and horizontal signals. Amplifiers U1 and U2 are the first amplification stage. Each amplifier outputs two signals that are inverted with respect to each other. Amplifier gain is varied by the control connected between the emitter resistors. The dc offset adjustment allows centering of the vertical and horizontal signals. Stages two and three include negative feedback for stability and fixed gain.

2.2 SCOPE HIGH VOLTAGE POWER SUPPLY

The scope high voltage power supply consists of a square wave generator, on delay, drive circuit, and the output voltage circuits.

2.2.1 The square wave generator is a standard timer configured for 50-percent duty cycle. R13 adjusts the output frequency from 18 kHz, (R13 shorted), to 26 kHz.

2.2.2 After the square wave generator output is divided and inverted with respect to each waveform, the on (low-high) transition of the next gates is delayed. The off (high-low) transition is not delayed.

2.2.3 The NPN/PNP transistor combination provides the drive for switching transistors Q2 and Q4. The negative voltage on the base of Q2 and Q4 is limited by diodes.

2.2.4 The −1200 volt and +140 volt outputs are full wave rectified to dc and filtered. The 6.3 volt ac is used for the CRT filament heater voltage.

2.3 SCOPE HIGH VOLTAGE BOARD

Opto-isolator U1 is used to drive transistor Q3 which switches the dc level of the grid. Q1 acts to decrease transition time. Resistive ladders set the proper voltage ranges for the INTENSITY, FOCUS, astigmatism, and trace rotation controls.

technical writing services
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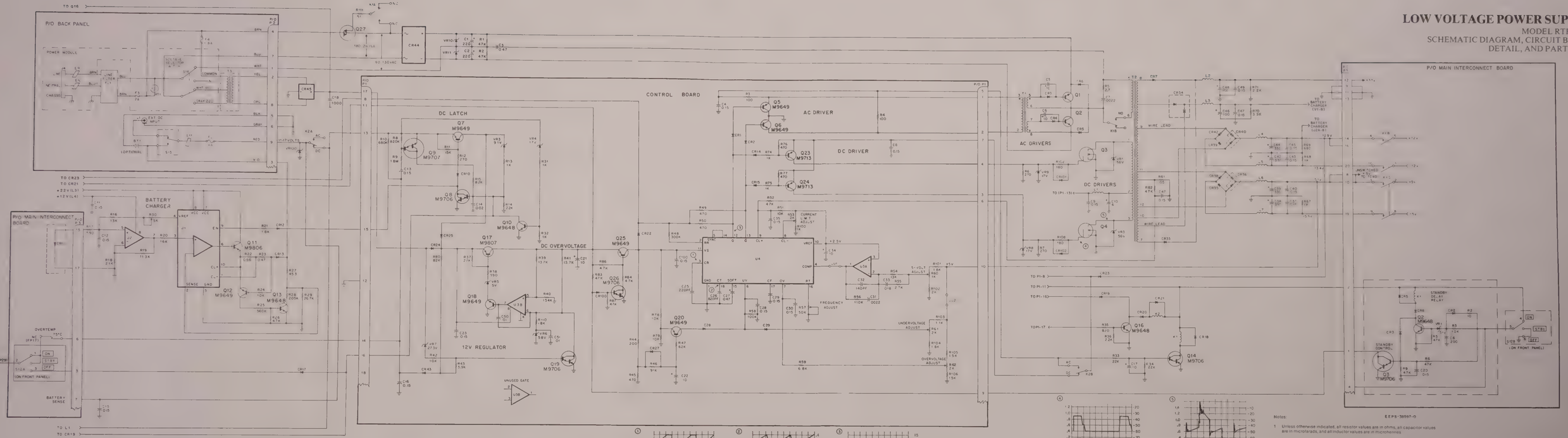
4/1/84-PHI

68P81064E52-A

LOW VOLTAGE POWER SUPPLY

MODEL RTP4018B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



Notes:

1. Unless otherwise indicated, all resistor values are in ohms, all capacitor values are in microfarads, and all inductor values are in microhenries.
2. IC types are TTL and CMOS devices.
3. Connections for integrated circuits are as follows:

Reference Number	Mfgr's Description	VCC	GND
U1	Voltage Reg	7	5
U2	Dual Op Amp	8	4
U3	Dual Op Amp	8	4
U4	Pulse Width Mod	11	1

Motorola No. PEPS-36840-B
(Sheet 2 of 2)
4/1/84-PHI

LOW VOLTAGE POWER SUPPLY

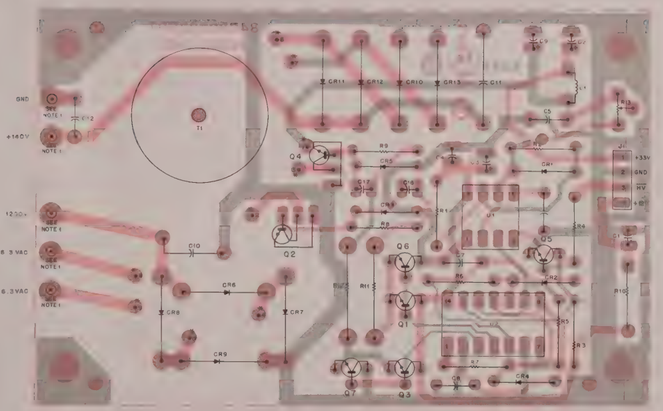
SCOPE MODULE
HIGH VOLTAGE POWER SUPPLY BOARD
MODEL RTP4020B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

parts list

RTP4020B High Voltage Power Supply Board — PL-8458-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ±10%, 250 V; unless otherwise stated
C1	23-84665F01	10 uF + 100-10%, 25 V
C2	23-84665F01	10 uF + 100-10%, 25 V
C3	23-84665F01	10 uF + 100-10%, 25 V
C4	21-84008H03	0.15 uF + 80-20%, 50 V
C5	21-840049	800 pF ± 5%, 300 V
C6	21-82428B40	.01 uF + 60-40%, 250 V
C7,8	21-840049	800 pF ± 5%, 300 V
C9	23-84998L01	2.2 uF ± 20%, 50 V
C10	21-82428B55	.0051 ± 10, 2000 V
C11	21-84008H15	0.47 uF + 80-20%, 400 V
C12	21-832502	.01 uF + 80-40%, 250 V
C13, 14	21-84008H03	0.15 uF + 80-20%, 50 V
		diode: (see note)
CR1-5, 8, 9	48-84044H01	silicon
CR6, 7, 8	48-84044H01	silicon
CR10, 11, 12, 13	48-82095C02	silicon
		connector, plug:
J1	24-80112B79	male 4-prong Tinnerman
		coil, rf:
L1	24-85649L01	choke: 600 uH
		transistor: (see note)
Q1	48-869706	NPN, type M9706
Q2	48-80396A95	NPN, type MJE243
Q3	48-869706	NPN, type M9706
Q4	48-80396A95	NPN, type MJE243
Q5	48-869570	NPN, type M9570
Q6	48-869649	PNP, type M9649
		resistor, fixed: ±5%, 1.4 W unless otherwise stated
R1	6-124B43A0	383k ± 1%, 1/8 W
R2	6-124B43A0	383k ± 1%, 1/8 W
R3	6-124A69	6.8k
R4	6-124A27	100
R5	6-124A69	6.8k
R6, 7	6-10621D17	18.2k ± 1%, 1/8 W
R8, 9	6-124A69	6.8k
R10	6-124A27	100
R11, 12	6-125B70	1; 1/2 W
R13	8-83432F32	10k, variable
		transformer
T1	25-80378A16	high voltage
		integrated circuit: (see note)
U1	51-83864U01	timer
U2	51-83864U49	quad exclusive or gate
		mechanical parts
	2-115123	NUT, 10-32 x 3/8 x 1/8"
	3-118030	SCREW, machine; 10-32 x 1"
	4-1712	WASHER, flat
	26-80378A69	SHIELD

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

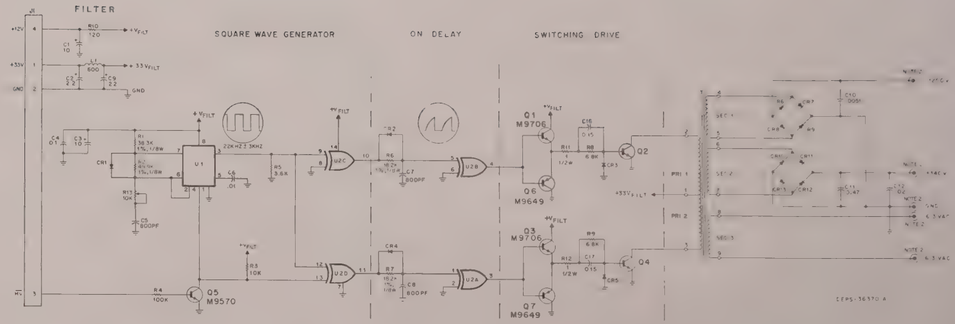


* CONNECTION POINT FOR WIRES FROM TRANSFORMER T1.

SHOWN FROM COMPONENT SIDE

BOLDER SIDE = 80-CEPS-36372-A
COMPONENT SIDE = 80-CEPS-36373-A
OL-CEPS-36371-B

NOTE
1 BUBBLE PINS FOR WIRES FROM HIGH VOLTAGE BOARD.



Notes

1. Unless otherwise specified, all resistors are in ohms, 1/4 watt, 5% all capacitors are in microfarads; all inductors are in microhennas.
2. Bubble pins for wires from high voltage board
3. Integrated circuits on this board are TTL and CMOS devices.

Reference Designation	Mfgr's Description	+V Fil.	Gnd
U1	Timer	8	1
U2	Quad Exclusive Or Gate	14	7

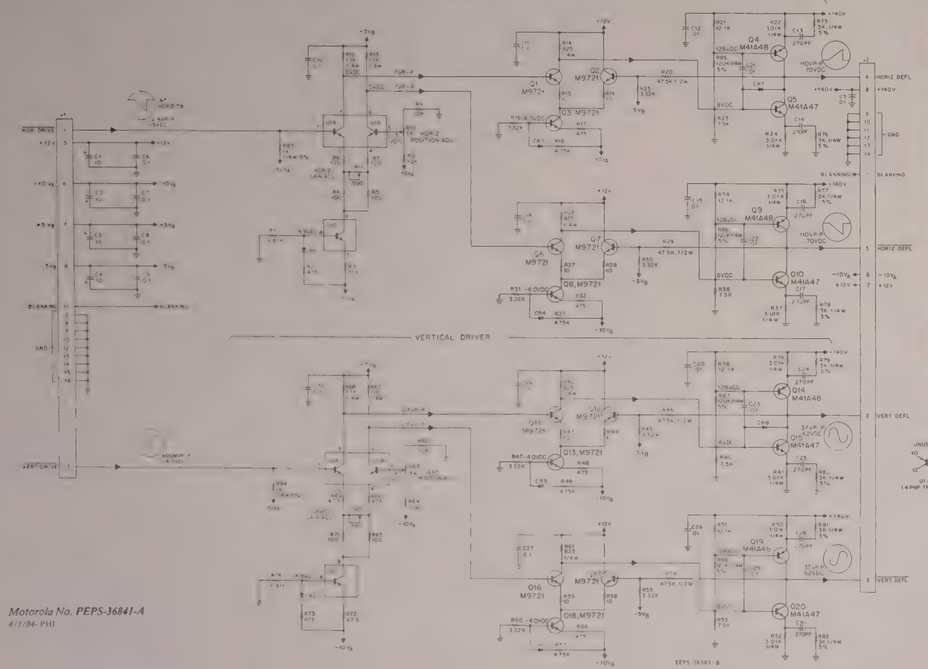
HIGH VOLTAGE POWER SUPPLY

Motorola No. PEPS-36843-A
4-12-84-FHH

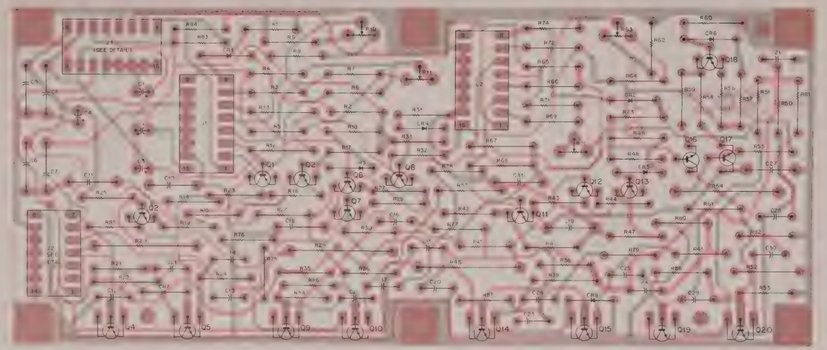
SCOPE MODULE

DRIVER BOARD

MODEL RTC4021B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



Motorola No. PEPS-36841-A
4/1/84- PHI



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE = 80-DEPS-36386-A
SOLDER SIDE = 80-DEPS-36385-A
OL-DEPS-36384-B

UNUSED FUNCTIONS

U1 AND U2
(4 PNP TRANSISTORS TOTAL)

NOTE

Unless otherwise specified all resistors are in ohms, 1%, 1/8 watt; all capacitors are in microfarads

Reference Designation	Manufacturer's Description	$-10V_A$	GND
U1	Transistor Array	Pin 16	Pins 10-15
U2	Transistor Array	Pin 16	Pins 10-15

J1 DETAIL

HOR DRIVE	1	16	
GND	2	15	
VERT DRIVE	3	14	GND
GND	4	13	
+12V	5	12	
$+10V_A$	6	11	BLANKING
+5V	7	10	GND
$-5V_B$	8	9	

J2 DETAIL

BLANKING	1	14	
VERT DEFL	2	13	
VERT DEFL	3	12	GND
HORIZ DEFL	4	11	
HORIZ DEFL	5	10	
$-10V_A$	6	9	
+12V	7	8	+140V

parts list

RTC4021B Scope Driver Board — PL-8457-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed uF; +60-40%, 250 V unless otherwise stated
C1, 2, 3, 4	23-84665F01	10 uF + 100-10%, 25 V
C5	21-82428B40	.01
C6 thru 11	21-82372C01	0.1 uF + 80-20%, 25 V
C12	21-82428B40	.01 uF
C13, 14	21-859178	270 pF ± 5%, 300 V
C15	21-82428B40	.01
C16, 17	21-859178	270 pF ± 5%, 300 V
C18, 19	21-82372C01	0.1 uF + 80-20%, 25 V
C20, 21, 22, 23	21-82428B40	.01
C24, 25	21-859179	270 pF ± 5%, 300 V
C26	21-82428B40	.01
C27	21-82372C01	0.1 uF + 80-20%, 25 V
C28	21-859179	270 pF ± 5%, 300 V
C29	21-82428B40	.01
C30	21-859179	270 pF ± 5%, 300 V
C31	21-82372C01	0.1 uF + 80-20%, 25 V
		diode: (see note)
CR1 thru 6	48-83654H01	silicon
CR7, 8	48-82420C15	silicon
		transistor: (see note)
Q1, 2, 3	48-869721	NPN, type 2N5209
Q4	48-80341A48	PNP, type MPSU60
Q5	48-80341A47	NPN, type MPSU10
Q6, 7, 8	48-869721	NPN, type 2N5209
U9	48-80341A48	PNP, type MPSU60
Q10	48-80341A47	NPN, type MPSU10
Q11, 12, 13	48-869721	NPN, type 2N5209
Q14	48-80341A48	PNP, type MPSU60
Q15	48-80341A47	NPN, type MPSU10
Q16, 17, 18	48-869721	NPN, type 2N5209
Q19	48-80341A48	PNP, type MPSU60
Q20	48-80341A47	NPN, type MPSU10
		resistor, fixed: ± 1%, 1/8 W unless otherwise stated
R1	6-10621C75	6.81k
R2	6-10621B63	475
R3	6-10621A89	51.1
R4, 5, 6, 7	6-10621A97	100
R8, 9	6-10621C91	10k
R10	18-83452F12	variable, 5k
R11	18-83452F98	variable, 500
R12, 13	6-80313A96	1.13k, 1/4 W
R14	6-84444A02	825, 1/4 W
R15	6-10621A01	10
R16	6-10621C45	3.32k
R17	6-10621B63	475
R18	6-10621C80	4.75k
R19	6-10621A01	10
R20	6-80378A20	47.5k, 1/2 W
R21	6-10621C99	12.1k
R22	6-80313A97	3.01k, 1/4 W
R23	6-10621C79	7.5k
R24	6-80313A97	3.01k, 1/4 W
R25	6-10621C45	3.32k
R26	6-84444A02	825, 1/4 W
R27, 28	6-10621A01	10
R29	6-80378A20	47.5k, 1/2 W
R30, 31	6-10621C45	3.32k
R32	6-10621B63	475
R33	6-10621C80	4.75k
R34	6-10621C99	12.1k
R35	6-80313A97	3.01k, 1/4 W
R36	6-10621C79	7.5k
R37	6-80313A97	3.01k, 1/4 W
R38	6-10621C99	12.1k
R39	6-80313A97	3.01k, 1/4 W
R40	6-10621C79	7.5k
R41	6-80313A97	3.01k, 1/4 W
R42	6-84444A02	825, 1/4 W
R43, 44	6-10621A01	10
R45	6-10621C45	3.32k
R46	6-80378A20	47.5k, 1/2 W
R47	6-10621C45	3.32k
R48	6-10621B63	475
R49	6-10621C80	4.75k
R50	6-80313A97	3.01k, 1/4 W
R51	6-10621C99	12.1k
R52	6-80313A97	3.01k, 1/4 W
R53	6-10621C79	7.5k
R54	6-80378A20	47.5k, 1/2 W
R55	6-10621C45	3.32k
R56	6-10621B63	475
R57	6-10621C80	4.75k
R58, 59	6-10621A01	10
R60	6-10621C45	3.32k
R61	6-84444A02	825, 1/4 W
R62	6-10621C91	10k
R63	18-83452F12	variable, 5k
R64	6-10621C91	10k
R65	6-10621A97	100
R66	6-10621A86	47.5
R67, 68	6-80313A96	1.13k, 1/4 W
R69	6-10621A85	47.5
R70	18-83452F12	variable, 5k
R71	6-10621A97	100
R72	6-10621A86	47.5
R73	6-10621B63	475
R74	6-10621C75	6.81k
R75 thru 82	6-124A80	3k ± 5%, 1/4 W
R83, 84	6-124A49	1k ± 5%, 1/4 W
R85 thru 88	6-124A09	120k ± 5%, 1/4 W
		integrated circuit (see note)
U1, 2	51-83629M10	linear transistor array
		mechanical parts
	9-84906E01	SOCKET, 14 contact
	9-84906E02	SOCKET, 16 contact

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

parts list

RTC4022A Scope Amplifier Board — PL-8455-A

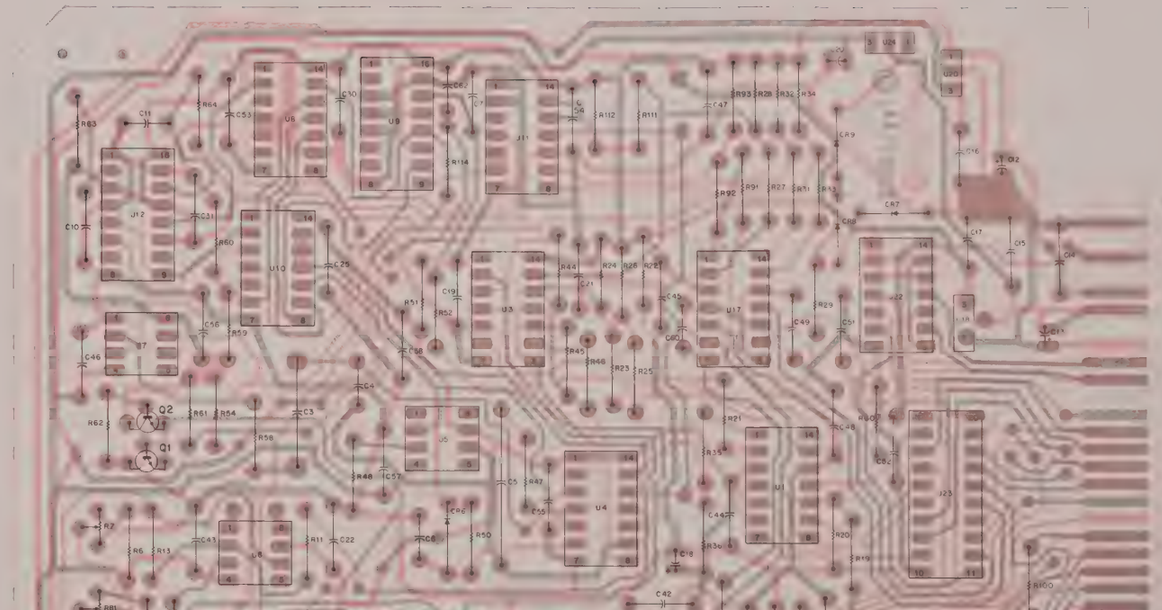
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF, ± 5%, 500 V unless otherwise stated
C1,2	21-82372C01	0.1 uF + 80-20%, 25 V
C3	20-83601B10	variable; 100
C4	21-840812	200
C5	8-82317B02	0.25 uF ± 10%; 100 V
C6	21-868681	47; 300 V
C7	21-847801	1000 uF
C8,9		NOT USED
C10	8-84637L22	0.22 uF ± 10%; 100 V
C11	21-850118	100
C12,13	23-84665F01	10 uF + 100-10%; 25 V
C14,15	8-84637L34	0.33 uF ± 10%; 100 V
C16,17	8-84637L31	.047 uF ± 10%, 250 V
C18	23-84665F01	10 uF + 100-10%; 25 V
C19	21-82372C01	0.1 uF + 80-20%, 25 V
C20	23-84665F01	10 uF + 100-10%, 25 V
C21,22	21-82372C01	0.1 uF + 80-20%, 25 V
C23		NOT USED
C24	21-832502	.02 uF + 60-40%, 250 V
C25 thru 58	21-82372C01	0.1 uF + 80-20%, 25 V
C59	21-847091	80 + 20%, 300 V
C60	21-863623	56
C61		NOT USED
C62	21-82187B27	.002 uF ± 10%; 200 V
		diode: (see note)
CR1,2	48-83654H01	silicon
CR3		NOT USED
CR4	48-83654H01	silicon
CR5	48-82466H01	silicon
CR6 thru 9	48-83654H01	silicon
		connector, receptacle:
J1	9-84231B02	female; single contact (phone)
J2	9-84906E02	female; 16 contact, IC
		transistor: (see note)
Q1	48-869571	PNP; type M9571
Q2	48-869570	NPN; type M9570
		resistor, fixed: ± 5%; 1/8 W: unless otherwise stated
R1	6-10621C75	6.81k ± 1%
R2	6-124A73	10k; 1/4 W
R3	6-10621C91	10k ± 1
R4	6-10621D29	24.1k ± 1%
R5	6-10621C75	6.81k ± 1%
R6	6-10621D49	39.2k ± 1%
R7	18-83452F32	variable; 10k
R8	6-10621C91	10k ± 1%
R9	6-10621D29	24.1k ± 1%
R10		NOT USED
R11	6-10621C79	7.5k ± 1%
R12		NOT USED
R13	6-10621C41	3.01k ± 1%
R14	6-10621C63	5.11k ± 1%
R15	6-10621C67	5.62k ± 1%
R16		NOT USED
R17	6-10621C91	10k ± 1%
R18	6-10621C24	2.0k ± 1%
R19	6-124A79	18k; 1/4 W
R20	6-124A53	1.5k; 1/4 W
R21	6-124A60	3k; 1/4 W
R22	6-124A69	6.8k; 1/4 W
R23	6-124A60	3k; 1/4 W
R24	6-124A69	6.8k; 1/4 W
R25	6-124A60	3k; 1/4 W
R26	6-124A69	6.8k; 1/4 W
R27	6-124A60	3k; 1/4 W
R28	6-124A77	15k; 1/4 W
R29	6-124A79	18k; 1/4 W
R30	6-124A53	1.5k; 1/4 W
R31 thru 36	6-124A66	5.1k; 1/4 W
R37		NOT USED
R38	6-10621C63	5.11k ± 1%
R39	6-10621B31	221 ± 1%
R40	18-83452F09	variable; 1k
R41	6-10621C91	10k ± 1%
R42	6-10621C63	5.11k ± 1%
R43	6-10621C91	10k ± 1%
R44	6-10621C74	6.65k ± 1%
R45	6-10621D71	66.5k ± 1%
R46	6-10621E68	665k ± 1%
R47	6-124A25	100; 1/4 W
R48	6-10621C63	5.11k ± 1%
R49		NOT USED
R50	6-124A92	62k; 1/4 W
R51	6-124B14	470k; 1/4 W
R52	6-124A73	10k; 1/4 W
R53		NOT USED
R54	6-124A65	4.7k; 1/4 W
R58	6-10621C63	5.11k ± 1%
R59,60	6-10621C91	10k ± 1%
R61,62	6-124A91	56k; 1/4 W
R63	6-124B21	910k; 1/4 W
R64	6-124A69	6.8k; 1/4 W
R65		NOT USED
R66	6-10621C63	5.11k ± 1%

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R69,70	6-10621B98	1.1k ± 1%
R71	6-10621A66	47.5 ± 1%
R72,73	5-84444A10	2.74k ± 1%
R74	6-10621A66	47.5k ± 1%
R75		NOT USED
R76	6-10621D41	32.4k ± 1%
R77	6-10621C49	3.85k ± 1%
R78	6-10621B52	365 ± 1%
R79	6-10621C20	1.82k ± 1%
R80		NOT USED
R81	18-83452F30	variable, 500
R82	6-124A38	360; 1/4 W
R83	6-10621D88	100k ± 1%
R84	6-10621C91	10k ± 1%
R85	6-10621D57	47.5k ± 1%
R86	6-10621C99	12.1k ± 1%
R87		NOT USED
R88	6-10621C88	9.31k ± 1%
R89	6-10621D88	100k ± 1%
R90	6-124A73	10k; 1/4 W
R91	6-124B37	4.3 meg; 1/4 W
R92,93	6-124A66	5.1k, 1/4 W
R94	6-10621C99	12.1k ± 1%
R95	6-10621C91	10k ± 1%
R96	6-10621D96	121k ± 1%
R97	6-10621C32	2.43k ± 1%
R98		NOT USED
R99	6-10621D55	137k ± 1%
R100	6-10621C91	10k ± 1%
R101		NOT USED
R102	6-124A68	6.2k, 1/4 W
R103 thru 110		NOT USED
R111	6-124A26	5.1k; 1/4 W
R112	6-124A75	12k; 1/4 W
R113		NOT USED
R114	6-124A01	10; 1/4 W
		integrated circuit: (see note)
U1	51-84371K59	quad comparator
U2	51-84371K63	dual operational amplifier
U3,4	51-82884L48	quad analog switch
U5,6	51-80365A09	operational amplifier
U7	51-80347A38	voltage comparator
U8	51-82884L13	dual D flip-flop
U9	51-82884L53	dual precision monostable multivibrator
U10	51-82884L17	triple 3-input NOR gate
U11	51-82884L05	quad 2-input NAND gate
U12	51-82884L53	dual precision monostable multivibrator
U13	51-80365A07	operational amplifier
U14	51-83629M10	linear transistor array
U15	51-84371K60	single operational amplifier
U16	51-80365A07	operational amplifier
U17	51-84371K59	quad comparator
U18	51-82609M20	negative voltage regulator
U19	51-80365A07	operational amplifier
U20	51-84561L76	positive voltage regulator
U21		NOT USED
U22	51-84561L38	triple 3-input NOR gate
U23	51-82609M17	octal D type flip flop
U24	51-80365A29	negative voltage regulator
		mechanical parts
	9-84906E02	SOCKET, 16 pin
	4-80395A42	ACTUATOR, ejector, 2 used
	75-80378A83	PAD

note For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

SCOPE AMPLIFIER BOARD

MODEL RTC4022A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



SHOWN FROM COMPONENT SIDE

COMPONENT SIDE ® BD - EEPS - 36262 - A
SOLDER SIDE BD - EEPS - 36263 - A
OVERLAY OL - EEPS - 36261 - B

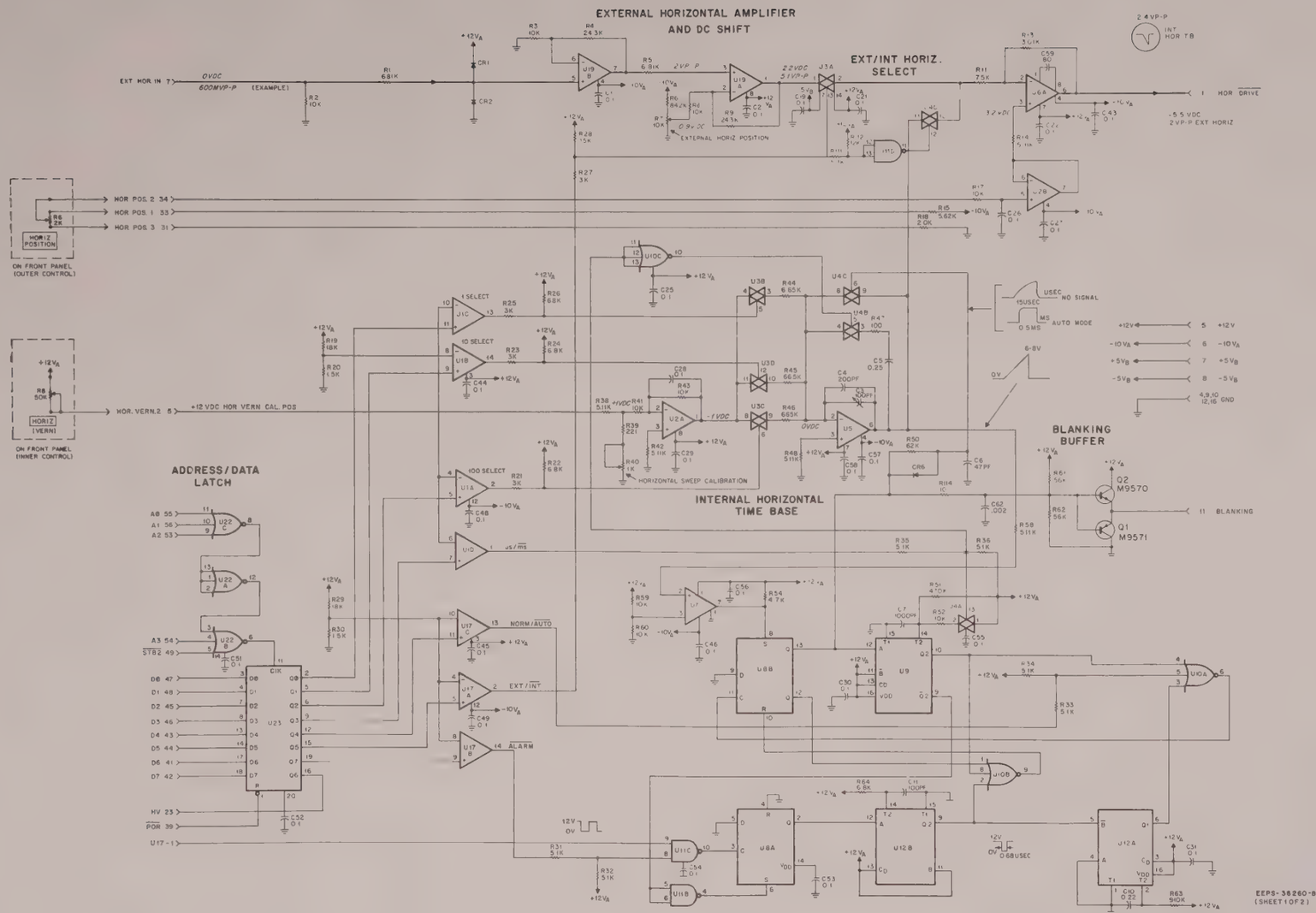
NOTE:
PIN NUMBERS AND SIGNAL NAMES IN PARENTHESES, ( ), ARE ON SOLDER SIDE.

Motorola No. PEPS-36844-A
(Sheet 1 of 3)
4 1 84 PHI

SCOPE AMPLIFIER BOARD

SCOPE AMPLIFIER BOARD

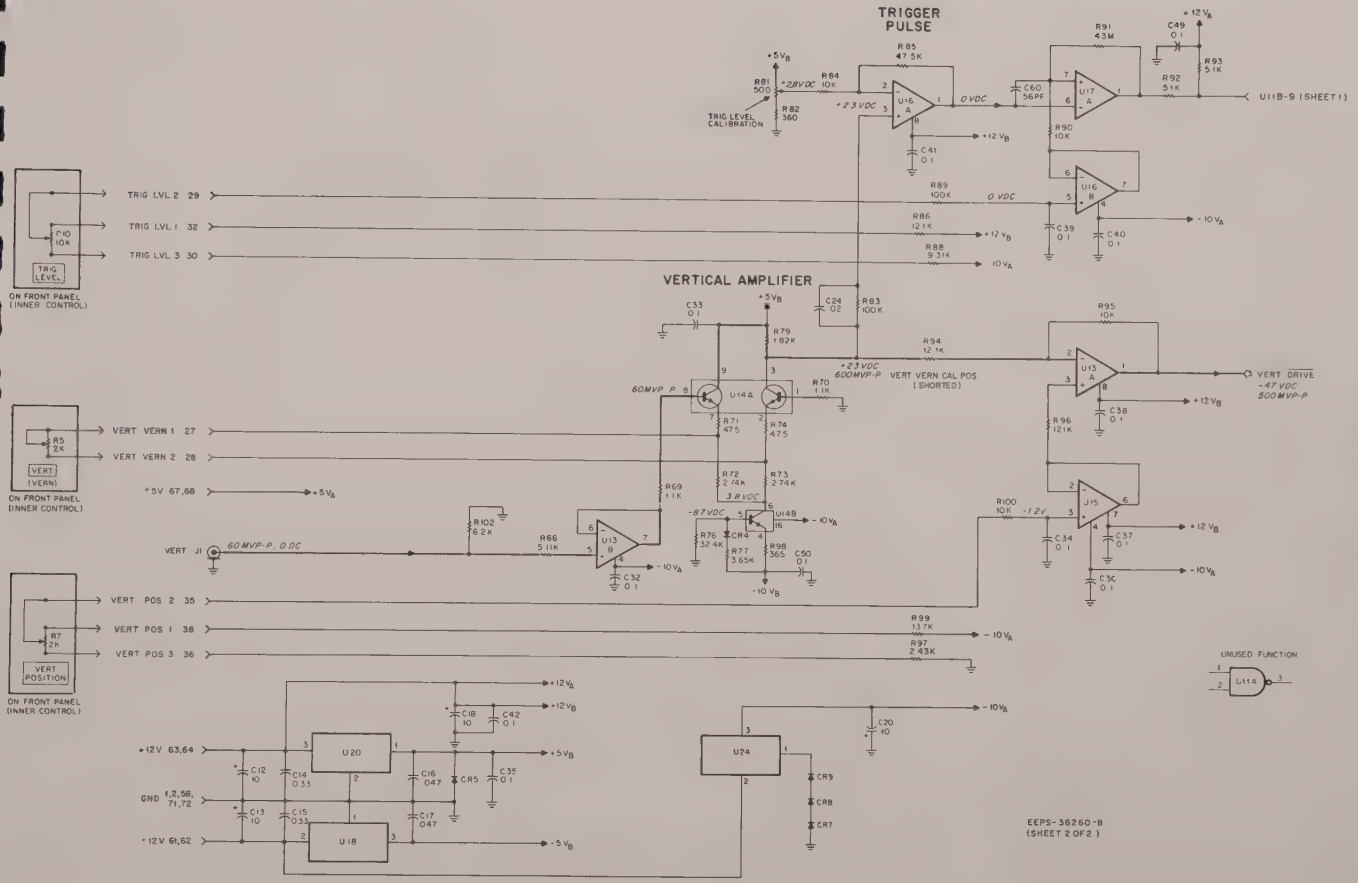
MODEL RTC4022A
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



Motorola No. PEPS-36844-A
(Sheet 2 of 3)
4/1/84- PHI

SCOPE AMPLIFIER BOARD

MODEL RTC4022A
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



NOTES

1. Unless otherwise indicated, all resistor values are in ohms, 1%, all capacitor values are microfarads and inductors are in microhenries
2. IC types are TTL and CMOS devices
3. Types and connections for the integrated circuits used on this board are as follows

Reference Designation	Mfgr's Description	+12 V_A (+12 V_B)	−10 V_A	−5 V_B	+5 V_A	GND	−12 V
U1	Quad Comparator	3	12				
U2	Dual Op Amp	8	4				
U3	Quad Analog Switch	14		7			
U4	Quad Analog Switch	14				7	
U5	Op Amp	7	4				
U6	Op Amp	7	4				
U7	Voltage Comparator	8	4			1	
U8	Dual-D Dlip-Flop	14				7	
U9	Dual Retrig Monostable	16				8	
U10	Triple 3-Input NOR	14				7	
U11	Quad 2-Input NAND	14				7	
U12	Dual Retrig Monostable	16				8	
U13	Dual Op Amp	(8)	4				
U14	NPN/PNP Trans Array		16				
U15	Op Amp	(7)	4				
U16	Dual Op Amp	(8)	4				
U17	Quad Comparator	3	12				
U18	Neg Voltage Reg					1	2
U19	Dual Op Amp	8	4				
U20	Pos Voltage Reg	3					
U22	Triple 3-Input NOR				14		
U23	Octal F-F Comm Clk				20	10	
U24	Neg Voltage Reg						2

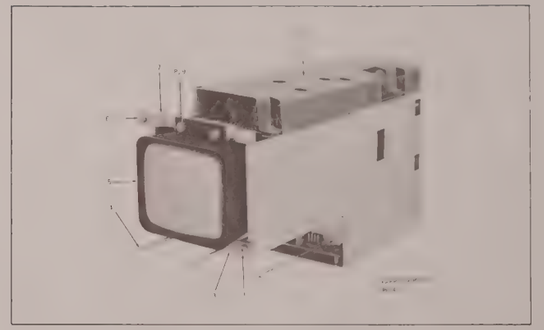
SCOPE AMPLIFIER BOARD

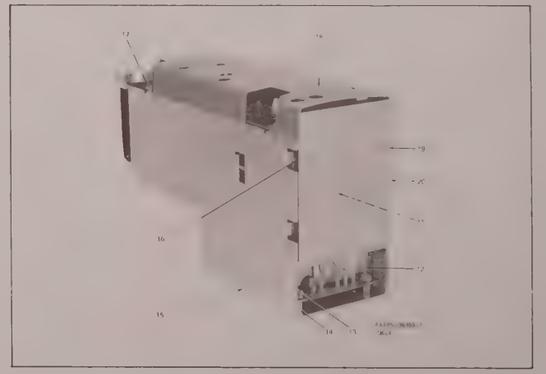
Motorola No. PEPS-36844-A
(Sheet 3 of 3)
4/1/84- PHI

parts list

RTC1004B Scope Module — PL-8470-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		coil; rf:
L1	24-80377A06	twist
		tube
V1	96-80377A04	CRT; type D7-201GH or D7-231GH
		referenced mechanical parts
1	7-80378A87	BRACKET, mounting
2	RTP4020B	HIGH VOLTAGE power supply (for reference only)
3	43-80336A37	BUSHING, 2 used
4	47-80378A88	SHAFT, extension; 1/4" dia; 2 used
5	25-80377A05	SHIELD, (CRT)
6	3-139013	SCREW, machine: 4-40 × 3/16", 2 used
7	7-80377A43	BRACKET
8, 13	2-131435	NUT, 4-40 x 1/4 x 3/32", 7 used
9	3-138804	SCREW, machine: 4-40 x 5/16", 3 used
10	RTC4021B	SCOPE DRIVER BOARD (for reference only)
11	RTP4019B	HIGH VOLTAGE BOARD (for reference only)
12	26-80378A89	SHIELD
14, 16	43-80397A41	STANDOFF, "hex": 1/4", 8 used
17	3-136890	SCREW, machine: 4-40 x 9/32": 10 used
18	14-80395A04	INSULATOR
19	3-139012	SCREW, machine: 4-40 × 1/4"; 8 used
20	64-80395A01	PLATE, back
		non-referenced mechanical parts
	5-80377A44	GROMMET
	7-80377A41	BRACKET
	7-80377A42	BRACKET
	42-84066A80	STRAP
	43-80370A69	SPACER (U/F4-40) 8 used
	58-80377A99	COUPLER; 2 used
	1-80307A72	ASSEMBLY CABLE, interconnect
	4-8434	WASHER, lock, 8 used





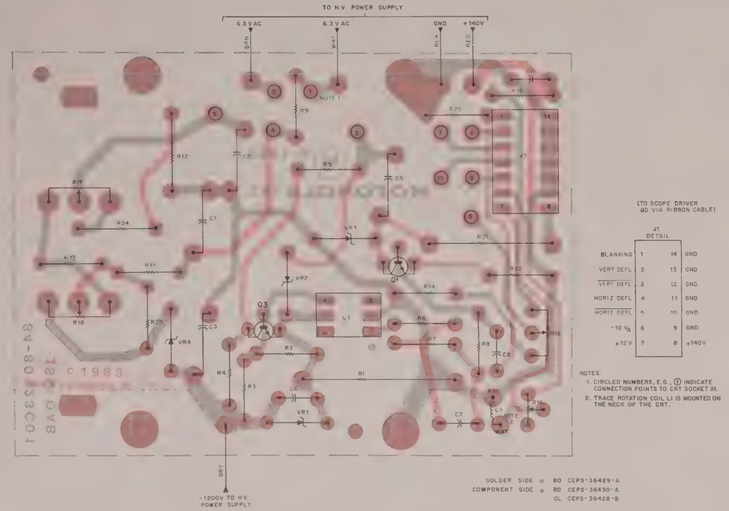
SCOPE MODULE
HIGH VOLTAGE BOARD
MODEL RTP4019B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

parts list

RTP4019B High Voltage Board PL4464A

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		capacitor, fixed
		connector, receptacle
		transistor, see note
		resistor, fixed, 1/2 W, 1/4 W
		integrated circuit, see note
VR1	48-83461E30	voltage regulator, see note; Zener, 53.6 V
VR2,3	48-80378A17	Zener, 100 V
VR4	48-83461E30	Zener, 53.6 V
X1	9-80377A07	socket, crt; female, 13 contact
		mechanical parts
	1-80350A01	SOCKET, crt assembly; includes:
	29-82713M01	TERMINAL, pin, male, 10 used
	29-10184A24	CONTACT, receptacle, 5 used

note: For optimum performance diodes, transistors, and integrated circuits must be ordered by Motorola part numbers



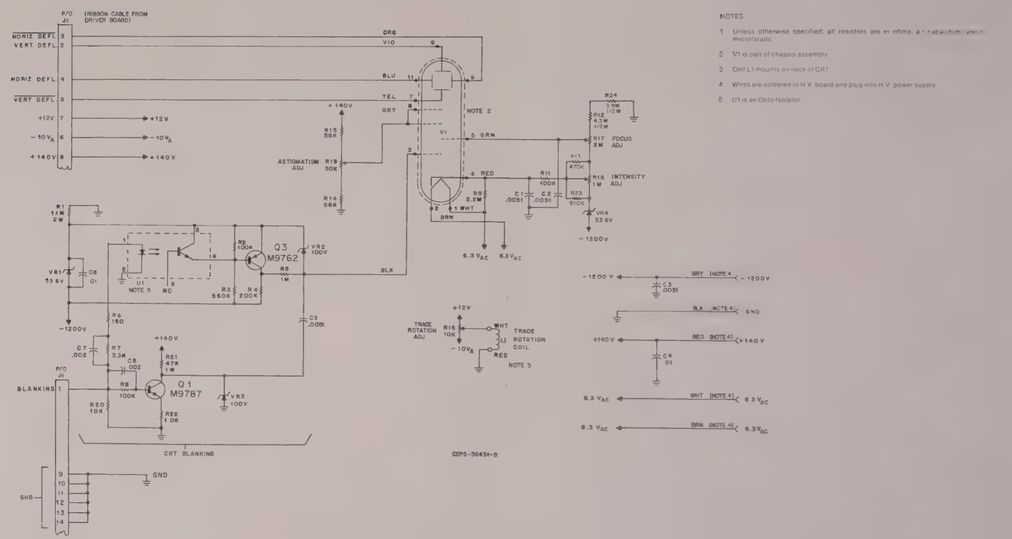
(TO SCOPE DRIVER BD VIA RIBBON CABLE)

J1 DETAIL			
BLANKING	1	14	GND
VERT DEFL	2	13	GND
VERT DEFL	3	12	GND
HORIZ DEFL	4	11	GND
HORIZ DEFL	5	10	GND
-10 V_A	6	9	GND
+12 V	7	8	+140V

NOTES:
1. CIRCLED NUMBERS, E.G., (1), INDICATE CONNECTION POINTS TO CRT SOCKET X1.
2. TRACE ROTATION COIL L1 IS MOUNTED ON THE NECK OF THE CRT.

SOLDER SIDE ⊕ BD CEPS-36429-A
COMPONENT SIDE ⊕ BD CEPS-36430-A
OL CEPS-36428-B

SHOWN FROM COMPONENT SIDE



NOTES:
1. Unless otherwise specified, all resistors are in ohms, ±5% tolerance, 1/4 W; all capacitors are in microfarads.
2. V1 is part of chassis assembly.
3. Coil L1 mounts on neck of CRT.
4. Wires are soldered to H.V. board and plug into H.V. power supply.
5. U1 is an Opto-Isolator.

RF SYNTHESIZER
MODEL RTC1001B

1. DESCRIPTION

The rf synthesizer provides an rf signal source for the frequency range from 10 kHz to 1 GHz in 100 Hz steps. The output frequency is programmed by the microprocessor through the rf control bus and is phase-locked to the 10 MHz frequency standard. A reference divider in the module produces outputs of 500 kHz, 50 kHz, 1 kHz, 100 Hz, and 50 Hz each having the same accuracy as the frequency standard. A block diagram of the rf synthesizer is shown in Figure 1.

2. THEORY OF OPERATION

2.1 GENERAL

2.1.1 Four phase-locked loops are used to generate the output frequency; a 60.5 MHz loop; a 310-440 MHz loop; the 500 MHz-1000 MHz loop; and the 550 MHz loop. Two of these loops contain programmable dividers, controlled by the microprocessor for varying the frequency. The 310-440 MHz loop is controlled by the four most significant digits of the required frequency and operates in discrete 50 kHz increments. The 60.5 MHz loop is controlled by the three least significant digits of the required frequency and operates in discrete 50 Hz increments.

2.1.2 The output is derived from three sources, covering the ranges of 10 kHz to 250 MHz, 250 MHz to 500 MHz, and 500 MHz to 1000 MHz. In the first range, 10 kHz to 250 MHz, the output is derived by mixing the fixed 550 MHz signal with 500-1000 MHz signal programmed for frequencies from 550.01 MHz to 800 MHz. For the second range, 250 to 500 MHz, the output is the result of a divide-by-two operation on the 500-1000 MHz signal. The final range is the direct output of the 500-1000 MHz loop. The appropriate frequency source is switched to the SYNTH RF output by the Output Select switch.

2.1.3 A basic flow diagram for programming the rf synthesizer is shown in Figure 2. This diagram includes generate and monitor considerations, wideband amplifier controls, and modulation control.

2.2 310-440 MHz PHASE-LOCKED LOOP

A single 310-440 MHz VCO (Voltage Controlled Oscillator) is phase-locked to the 50 kHz reference input using a loop. The VCO output is divided down to 50 kHz using a programmable two modulus prescaler and divider. Programming of the divider is controlled by the microprocessor to give output frequencies from 310 to 440 MHz in 50 kHz steps.

2.3 60.5 MHz PHASE-LOCKED LOOP

The 60.5 MHz loop is programmable over a ± 100 kHz range in 50 Hz increments. The 60.5 MHz VCO output is mixed with a 50 MHz signal from the 550 MHz loop. A programmable divider following the mixer divides the 10.5 MHz ± 100 kHz signal down to the 50 Hz reference frequency. A comparison between the divider output and the reference signal by the phase/frequency detector results in an error voltage to the VCO which maintains the phase lock.

2.4 550 MHz PHASE-LOCKED LOOP

A fixed frequency of 550 MHz is obtained by dividing the 550 MHz VCO by 55 to obtain 10 MHz. The 10 MHz from the divider is compared with the 10 MHz frequency standard in the phase/frequency detector. The resulting error signal is filtered and used to correct the 550 MHz VCO to maintain the phase lock. A voltage controlled attenuator follows the 550 MHz output to control the output level of the generator output for frequencies below 1 MHz. The leveling loop in the rf input module provides the ALC VOLT control signal to maintain the required output level at the front panel rf jack.

2.5 500-1000 MHz PHASE-LOCKED LOOP

The 500-1000 MHz output is locked to either the sum or the difference of the 310-440 MHz and 60.5 MHz loop output frequencies. In the locked condition, mixing the divide-by-two output of the 500-1000 MHz VCO with the 310-440 MHz signal gives a difference frequency equal to the 60.5 MHz output. There are two frequencies of the divide-by-two output, the 310-440

the other. Thus, the phase switch following the phase/frequency detector determines the frequency the loop locks on.

2.6 MODULATION CONTROL

Modulation of the tuning voltage for the 60.5 MHz VCO provides the frequency modulation of the rf output. Since the modulation sensitivity changes by a factor of two when the 250-500 MHz source is selected, the modulation control provides programmable gain control to maintain constant sensitivity at the FM MOD input. Additionally, the wideband modulation mode requires a gain of four beyond that for the narrowband mode. Thus, under control of the microprocessor, the modulation control selects gains of 1, 2, 4, and 8 for the FM MOD input. Input modulation sensitivities are 5 kHz/volt and 20 kHz/volt for narrow and wideband FM input.

2.7 MODULE CONTROL

Control information is latched into four-bit control latches which are loaded by the microprocessor through the rf control bus. The four-bit RF ADD BUS Ø-3 data is decoded by the address decoder to determine into which control latch the four-bit RF DATA BUS Ø-3 data is to be stored. Synchronization of the data transfer is the function of the RF BUS EN line. One control latch output, LO/HI BAND SEL, is applied to the rf input module to control the frequency range of the output amplifier.

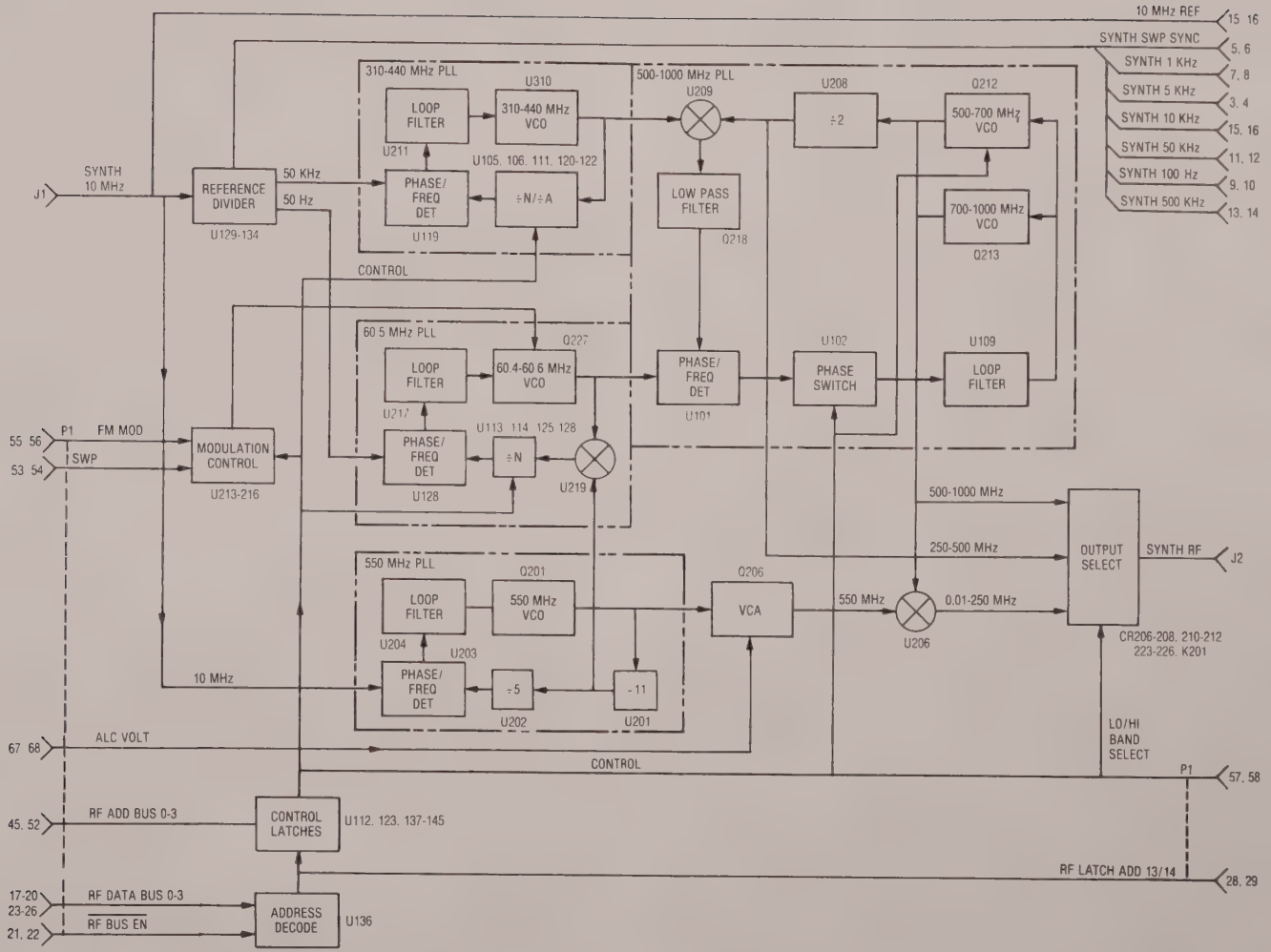


Figure 1. RF Synthesizer Functional Block Diagram

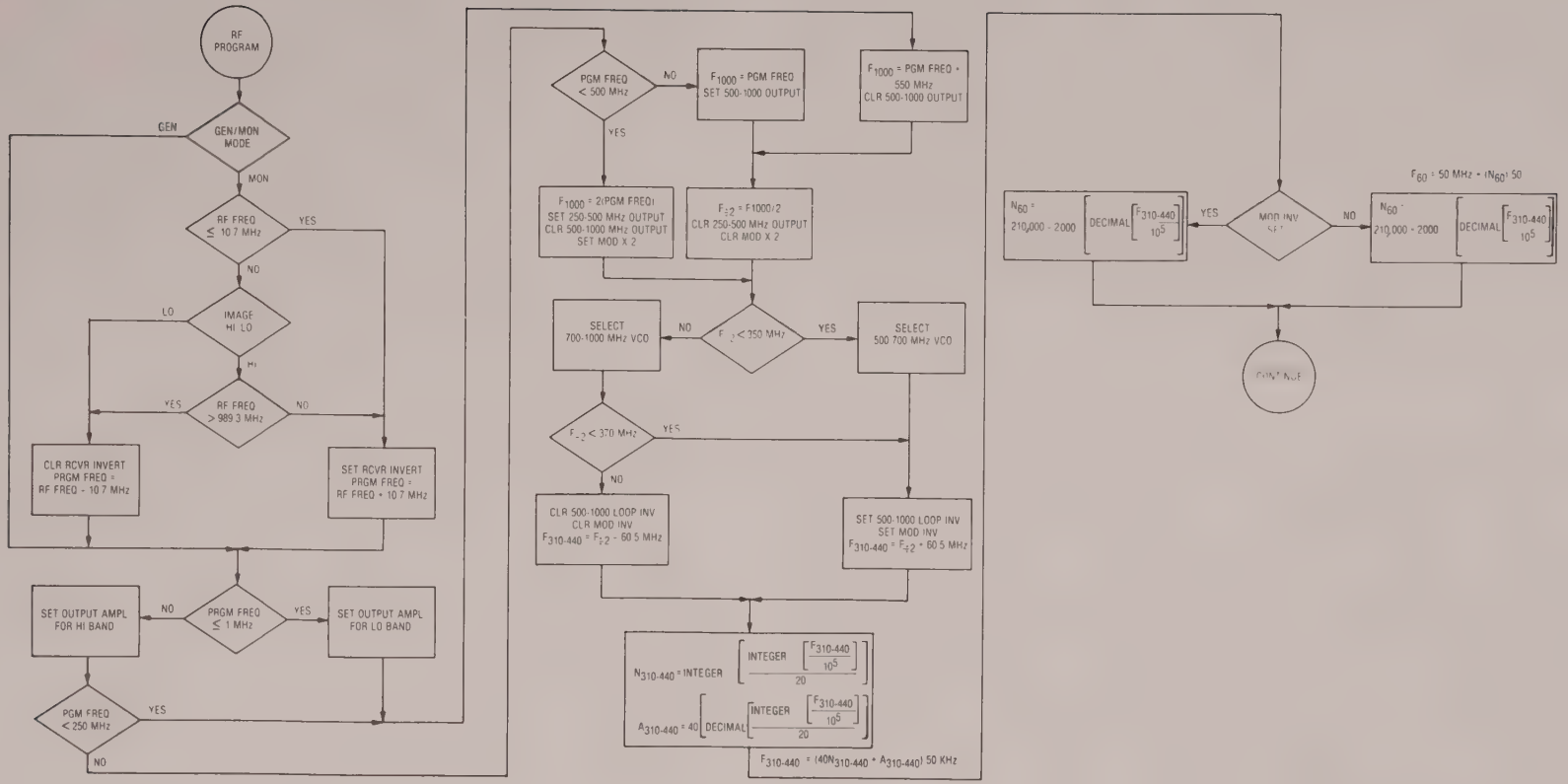
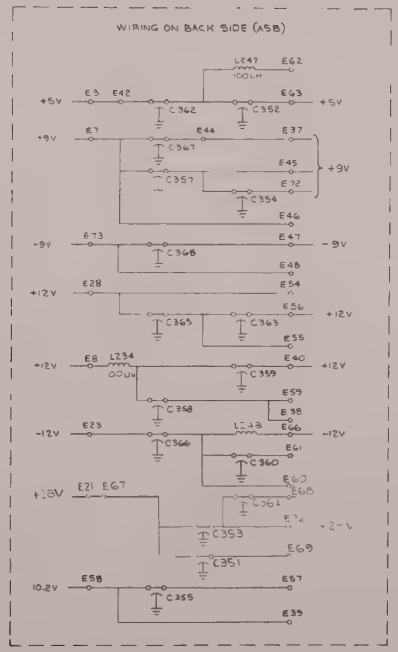
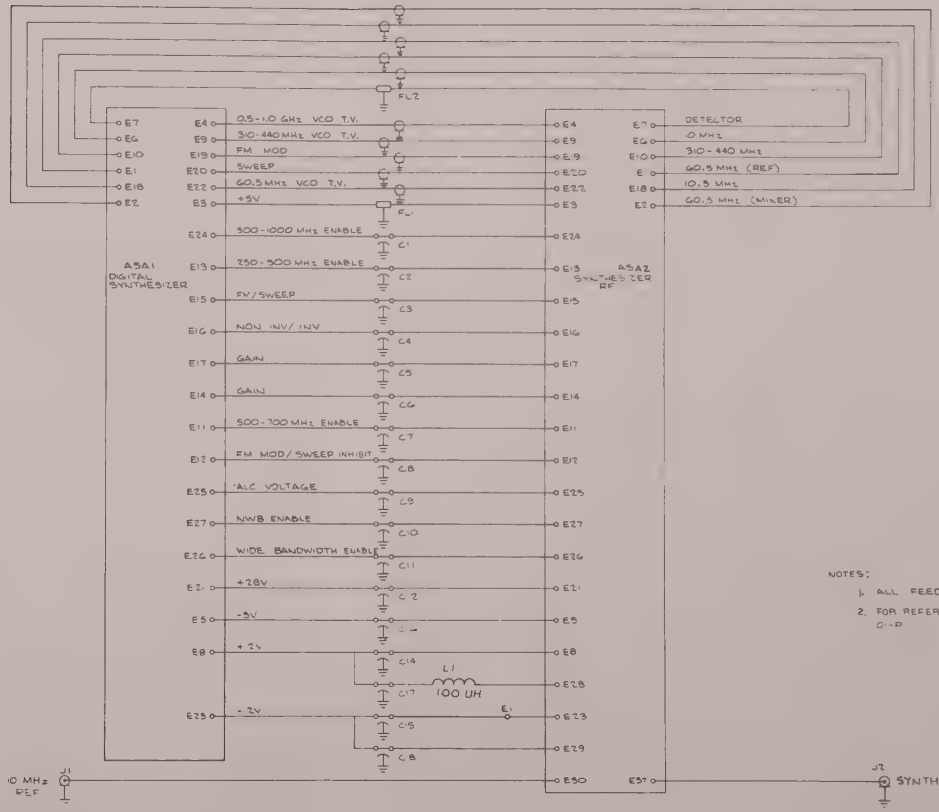

RF PROGRAM
GEN/MON MODE
GEN
MON
RF FREQ ≤ 10.7 MHz
YES
NO
IMAGE HI LO
LO
HI
RF FREQ > 989.3 MHz
YES
NO
CLR RCVR INVERT PRGM FREQ = RF FREQ - 10.7 MHz
SET RCVR INVERT PRGM FREQ = RF FREQ + 10.7 MHz
SET OUTPUT AMPL FOR HI BAND
PRGM FREQ ≤ 1 MHz
NO
YES
SET OUTPUT AMPL FOR LO BAND
PGM FREQ < 250 MHz
YES
NO
PGM FREQ < 500 MHz
NO
YES
F1000 = PGM FREQ SET 500-1000 OUTPUT
F1000 = PGM FREQ + 550 MHz CLR 500-1000 OUTPUT
F1000 = 2(PGM FREQ) SET 250-500 MHz OUTPUT CLR 500-1000 MHz OUTPUT SET MOD X 2
F÷2 = F1000/2 CLR 250-500 MHz OUTPUT CLR MOD X 2
SELECT 700-1000 MHz VCO
NO
F÷2 < 350 MHz
YES
SELECT 500 700 MHz VCO
F÷2 < 370 MHz
YES
NO
CLR 500-1000 LOOP INV CLR MOD INV F310-440 = F÷2 - 60.5 MHz
SET 500-1000 LOOP INV SET MOD INV F310-440 = F÷2 + 60.5 MHz
N310-440 = INTEGER [INTEGER [F310-440 / 10^5] / 20]
A310-440 = 40 [DECIMAL [INTEGER [F310-440 / 10^5] / 20]]
F310-440 = (40N310-440 + A310-440) 50 KHz
N60 = 210,000 - 2000 [DECIMAL [F310-440 / 10^5]]
YES
MOD INV
NO
N60 = 210,000 - 2000 [DECIMAL [F310-440 / 10^5]]
F60 = 50 MHz + (N60) 50

Figure 2. Frequency Programming Flow Diagram

RF SYNTHESIZER

MODEL RTC1001B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST





NOTES:

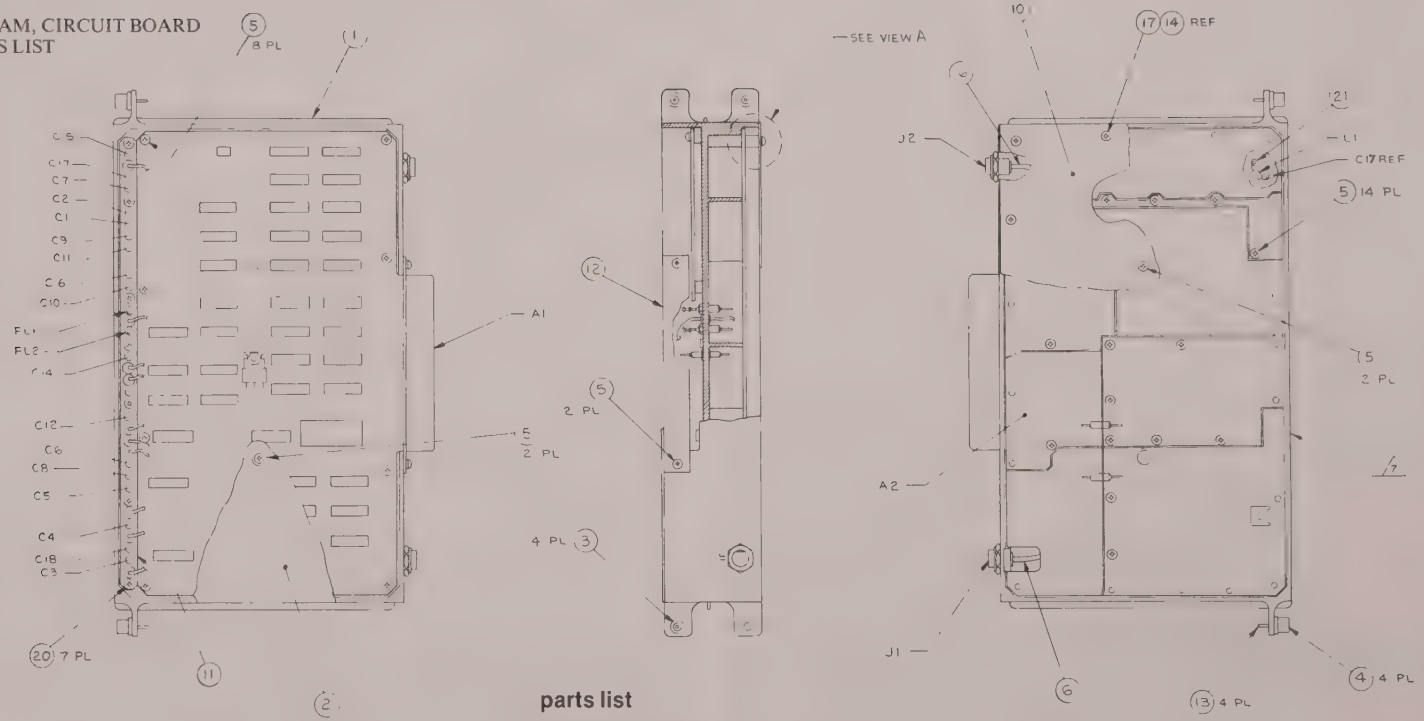
1. ALL FEED THRU CAPACITORS ARE 5000 PF
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P [illegible] ASSEMBLY [illegible]

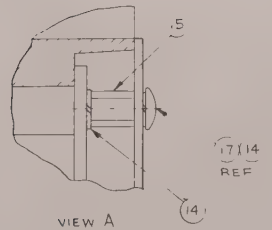
Motorola No. PEPS-37063-B
(Sheet 1 of 2)
4/1/84- PHJ

RF SYNTHESIZER

RF SYNTHESIZER

MODEL RTC1001B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST





VIEW A
SCALE: 4/1
19 PLACES

parts list

RTC1001B Synthesizer Kit — PL-8482 A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed pF: ± 80-20%; 500:
C1 thru 12	21-82543H03	5000
C14 thru 17	21-82543H03	5000
		connector, receptacle:
J1	1-80305A78	female; single contact
J2	9-80331A79	female, single contact
		filter:
FL1, 2	91-87679C01	1500 pF @ 25°C
		coil, rf:
L1	24-80369A37	choke; 100 uH
REF. NO.		**MECHANICAL PARTS**
1	27-80335A34	CHASSIS, synthesizer
2	15-80335A37	COVER, digital synthesizer
3	5-84500B03	EYELET, special; 4 used
4	42-84284B01	RETAINER; 4 used
5	3-138804	SCREW, machine; 4-40 × 5/16"; 28 used
6		Part of J1
10	15-80335A36	COVER, synthesizer RF
11	26-80370A67	SHIELD
12	64-80370A68	PLATE, connector
13	3-139581	SCREW, machine; 4-40 × 5/16", 4 used
14	4-114583	LOCKWASHER, #4 split, 38 used
15	43-80370A69	SPACER, MF 4-40; 19 used
16		Part of J2
17	3-136786	SCREW, machine; 4-40 × 1/4"; 19 used
20	3-139012	SCREW, machine; 4-40 × 1/4"; 7 used
21	29-80377A75	TERMINAL

SCOPE AMPLIFIER BOARD

MODEL RTC4022A

1. DESCRIPTION

1.1 The scope amplifier board develops the signals necessary to drive the scope module. AC and dc voltages are developed for the scope driver board. In addition, vertical signal amplification and dc level shift are provided. A blanking signal is applied to the scope high voltage board.

1.2 The scope amplifier operates in auto or normal modes. When a triggerable vertical signal is present, a sweep is developed in both auto or normal modes. When a triggerable signal is not present, the sweep is blanked in the normal mode and free running in the auto mode. An external horizontal input is available at the front panel.

2. THEORY OF OPERATION

2.1 ADDRESS/DATA LATCH

When address lines AØ-A3 are low, the scope data lines DØ-D7 are clocked into latch U23. The output of U23 is buffered and level shifted by U1 and U17.

2.2 INTERNAL HORIZONTAL TIME BASE

An internal horizontal time base is generated by a ramp generator and the blanking and trigger hold off circuitry.

2.2.1 Ramp Generator

The ramp signal is developed using an integrator with a constant voltage applied. The sweep rate is determined by R44, R45, R46 and C3, C4, and C5. The combinations of the RC network produce six sweep rates over a six decade range between 1 microsecond and 100 milliseconds.

2.2.2 Blanking and Trigger Hold Off Circuitry

2.2.2.1 When the ramp voltage reaches 6 volts, the output of U8B is a blanking pulse which is used to short circuit the integrator (via switch U4C) and develop a hold off time (U9B). During this time, U8A and U10B are disabled. In the normal triggering mode, U10B is always disabled thus keeping the blanking signal high and preventing the ramp from starting until a trigger pulse is present at U12B. The output of U12B is a negative- going pulse to U10A, which resets U8B if all other inputs are low. This starts the ramp signal.

2.2.2.2 In the auto triggering mode with no trigger pulse present, U9B allows sufficient time for the retrace to occur before applying a low to U10B. When this occurs, U8B is clocked low and the ramp cycle begins. U12A delays the free-running auto triggering by disabling U10B for about 0.2 seconds following the last trigger pulse from U12B. Free-run operation begins if there are no other trigger pulses during that time.

2.3 EXTERNAL HORIZONTAL

An externally generated horizontal signal applied to the EXT HORIZ input jack on the service monitor front panel is amplified and level shifted by U19A and U19B.

2.4 VERTICAL AMPLIFIER

Amplifier U14 forms a differential amplifier and current source for amplifying the vertical signal. A VERTical vernier control on the front panel is connected between emitter resistors and is used to control gain. When in the calibrated position (fully CCW), maximum signal gain is attained.

2.5 TRIGGER LEVEL/OUTPUT

The amplified vertical signal is compared to the trigger level set by the TRIG LEVEL control. The output signal is a squarewave with the duty cycle dependent upon the control setting. The high-to-low transition coincides with a point on the rising edge of the vertical signal input from the front panel interface board.

parts list

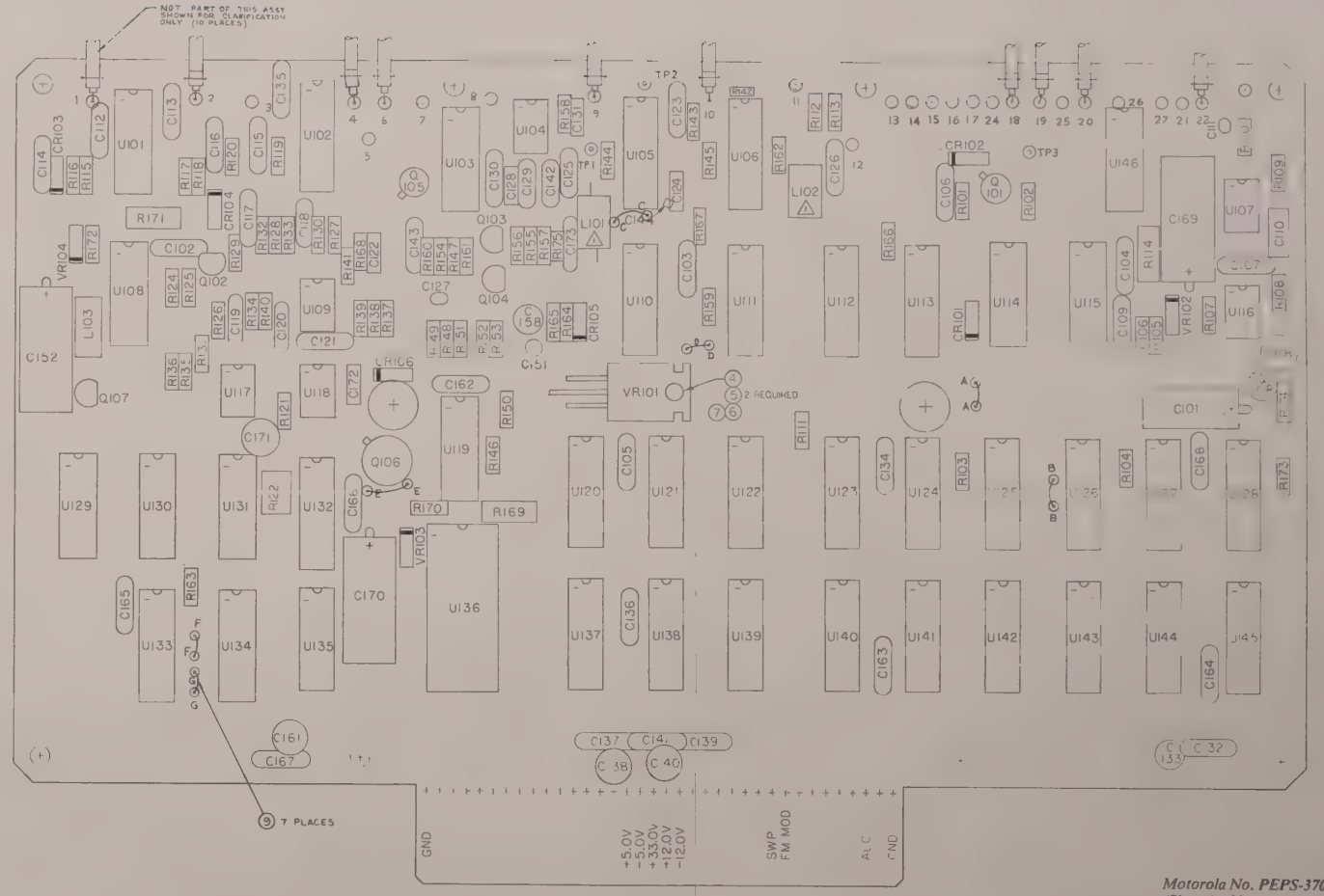
RTC4009B RF Synthesizer Digital Board — FL-8502-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, pF ± 10%; 100 V: unless otherwise stated
C101	23-80369A65	20 uF + 75-10%, 16 V
C102 thru 105	21-82187B14	1000
C106	21-84494B46	180 ± 3%, 500 V
C107	21-82372C10	05 uF ± 20; 25 V
C108	23-84665F01	10 uF, 25 V
C109	21-82428B59	01 uF + 80-20%; 200 V
C110	23-80369A61	10 uF ± 20%, 35 V
C111	23-82397D50	0.22 uF ± 20%, 35 V
C112 thru 114	21-82428B59	.01 uF + 80-10% , 200 V
C115, 116	21-84494B37	11 ± 5%, 500 V
C117, 118	21-84494B24	39 ± 5%, 500 V
C119, 120	21-82428B10	3300
C121	21-82428B59	.01 uF + 80-20%; 200 V
C122	21-80369A82	0.1 uF ± 20%
C123	21-82187B07	470 ± 10%; 500 V
C124	21-80369A82	0.1 uF ± 20%
C125, 126	21-82187B14	1000
C127	23-82397D04	15 pF ± 20%; 15 V
C128	21-80370A02	2200
C129	23-80369A61	10 uF ± 20%, 35 V
C130	21-82428B59	.01 uF + 80-10%; 200 V
C131	21-80369A99	01 uF
C132	21-82187B14	1000
C133	23-84665F01	10 uF, 25 V
C134 thru 137	21-82187B14	1000
C138	23-84665F01	10 uF, 25 V
C139	21-82187B14	1000
C140	23-84665F01	10 uF; 25 V
C141	21-82187B14	1000
C142	23-80369A61	10 uF ± 20%; 35 V
C143	21-82187B04	270; 500 V
C144	21-80376A12	33 ± 5%; 50 V (chip)
C151	23-84665F04	1.0 uF ± 20%, 50 V
C152	23-84665F10	100 uF; 25 V
C158	23-84665F01	10 uF, 25 V
C161	23-84665F01	10 uF, 25 V
C162 thru 168	21-82187B14	1000
C169, 170	23-84665F10	100 uF, 25 V
C171	23-84665F01	10 uF, 25 V
C172	21-80369A99	.01 uF
C173	21-82187B14	001 uF
		diode:
CR101	48-B4616A01	hot carrier
CR102, 103, 104	48-83617C01	silicon
CR105	48-86850C47	silicon
CR106	48-82617C01	silicon
		coil:
L101 102	24-83977B02	
L103	24-80370A39	inductor, 12 mH
		transistor:
Q101	48-84308A92	NPN
Q102	48-869570	NPN, type M9570
Q103	48-869571	PNP, type M9571
Q104	48-869570	NPN, type M9570
Q105	48-84308A92	NPN
Q106	48-86851C32	NPN
Q107	48-869570	NPN; type M9570
Q108	48-2089C01	NPN
		resistor: ± 5%; 1/4 W: unless otherwise stated
R101	6-124A73	R10k
R102	6-124A49	1k
R103 thru 106	6-124A73	10k
R107	6-124B16	560k
R108	6-124A49	1k
R109	6-124A53	1.5k
R110	6-124A90	51k
R111, 112, 113	6-124A56	2.0k
R114	6-125A45	680; 1/2 W
R115	6-124A56	2.0k
R116	6-124A41	470
R117	6-124A56	2.0k
R118, 119, 120	6-124A41	470
R121	6-124B19	750k
R122	18-83452F19	variable, 100k
R124, 125, 126	6-124A49	1k
R127, 128	6-124A41	470
R129, 130	6-124A53	1 5k
R131	6-124A73	10k
R132, 133	6-124A53	1.5k
R134	6-124A39	390
R135	6-124A56	2.0k
R136	6-124A59	2.7k
R137	6-124A25	100
R138	6-124A61	3.3k
R139	6-124A71	8.2k
R140	6-124A39	390
R141	6-124A49	1k
R142	6-185A18	51; 1/8 W
R143	6-124A49	1k

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R144, 145	6-124A41	470
R146	6-124A51	1 2k
R147	6-124A07	18
R148	6-124A53	1.5k
R149	6-124A35	270
R150, 151	6-124A41	470
R152	6-124A57	2.2k
R153	6-124A23	82
R154, 155	6-124A77	15k
R156	6-124A69	6 8k
R157, 158, 159	6-124A49	1k
R160	6-124A73	10k
R161	6-124A49	1k
R162	6-124A41	470
R163	6-124A73	10k
R164	6-124A65	4.7k
R165	6-124A41	470
R166	6-124A56	2.0k
R167, 168	6-124A41	470
R169	6-125A13	33; 1/2 W
R170	6-124A47	820
R171	6-125A43	560, 1/2 W
R172	6-124A63	3 9k
R173	6-124A73	10k
R174	6-124A27	120
R175	6-185A49	1000; 1/8 W
		integrated circuit:
U101	51-80365A01	phase frequency detector
U102	51-80365A03	quad exclusive OR gate
U103	51-82884L48	quad bilateral switch
U104	51-80365A07	op amp
U105	51-84561L53	modulus prescaler
U106	51-84561L55	dual D flip-flop
U107	51-83629M07	op amp
U108	51-82884L48	quad bilateral switch
U109	51-83629M07	op amp
U110	51-80355A05	counter circuit logic unit
U111	51-82609M54	4-bit binary synch up/down counter
U112	51-82884L15	quad clocked "D" latch
U113	51-80365A05	counter control logic unit
U114	51-84561L45	dual 4-input AND gate
U115	51-82884L48	quad bilateral switch
U116	51-83629M07	op amp
U117, 118	51-80365A08	op amp
U119	51-84371K99	phase-frequency detector
U120, 121, 122	51-82609M54	4-bit binary synch up/down counter
U123	51-82884L15	quad clocked "D" latch
U124 thru 127	51-82609M54	4-bit binary synch up/down counter
U128	51-83627M26	phase frequency detector
U129	51-82609M02	dual JK flip-flop
U130	51-84561L03	hex inverter
U131	51-82609M02	dual JK flip-flop
U132, 133	51-82609M68	dual decade counter
U134	51-82884L12	dual 4-bit decade counter
U135	51-84561L03	hex inverter
U136	51-82884L32	4-bit latch/4-16 line decoder
U137 thru 145	51-82884L15	quad clocked "D" latch
U146	51-82884L04	quad 2-input NOR gate
		voltage regulator:
VR101	51-80365A17	3-terminal
VR102, 103	48-83193A59	Zener, 5 6 V ± 5%; 0 4 W
VR104	48-82256C50	Zener, 3.09 V ± 5%; 0 4 W

REF. NO.	MECHANICAL PARTS	
1	84-80335A22	PWB, digital synthesizer
2	SN63WRP3	SOLDER
3	11-14167A01	INK, BLACK
4	MS35206-214	SCREW, Phillips, 4-40 × 0.312"
5	4-7007	WASHER, flat, No 4
6	4-114583	WASHER, lock; No. 4
7	2-7019	NUT, hex, 4-40
9		WIRE, 24
10	M23053/5-206-C	INSULATION SLEEVING, 0 250 CLR

RF SYNTHESIZER
DIGITAL BOARD
MODEL RTC4009B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



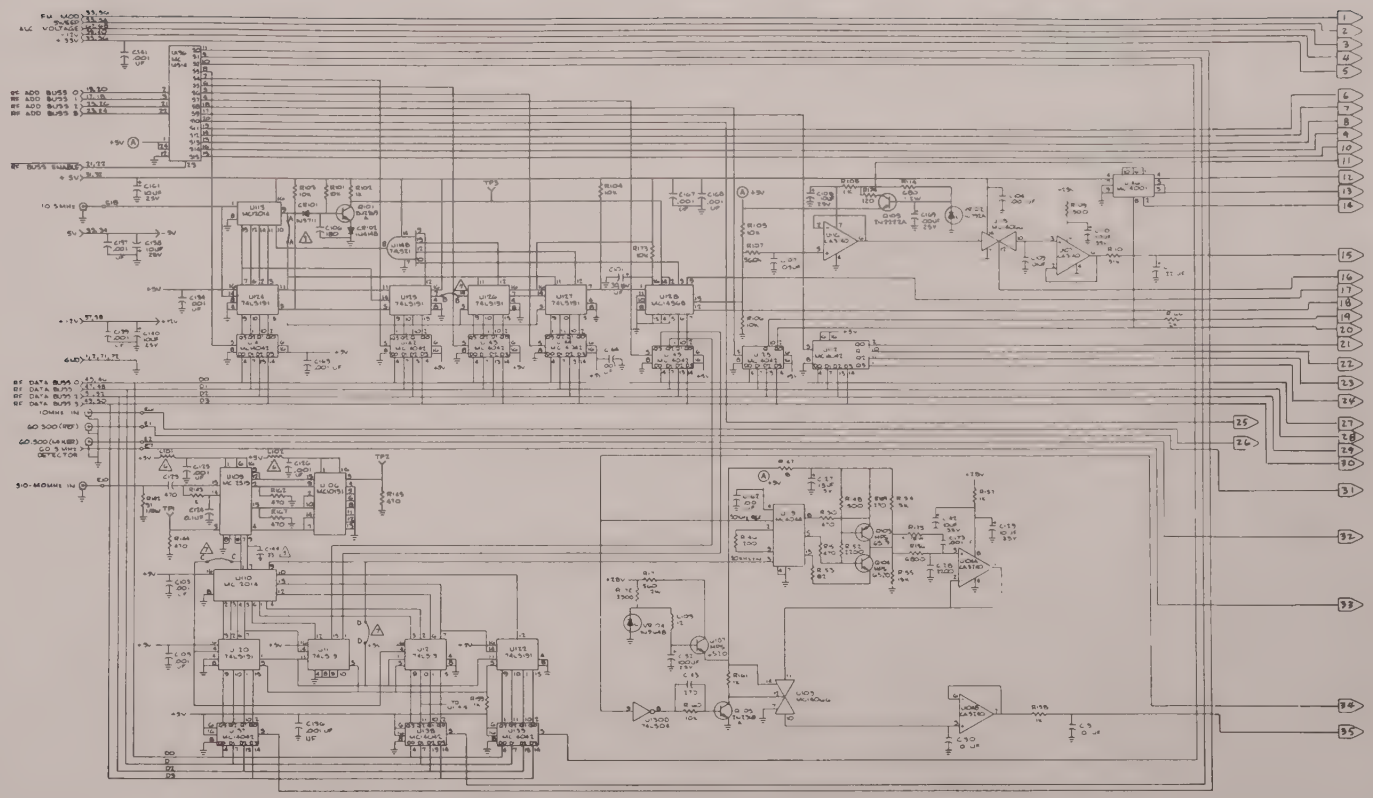
Motorola No. PEPS-37064-B
(Sheet 1 of 3)
4/1/84- PHI

RF SYNTHESIZER DIGITAL BOARD

RF SYNTHESIZER

DIGITAL BOARD

MODEL RTC4009B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



Motorola No. PEPS-37064-B
(Sheet 2 of 3)
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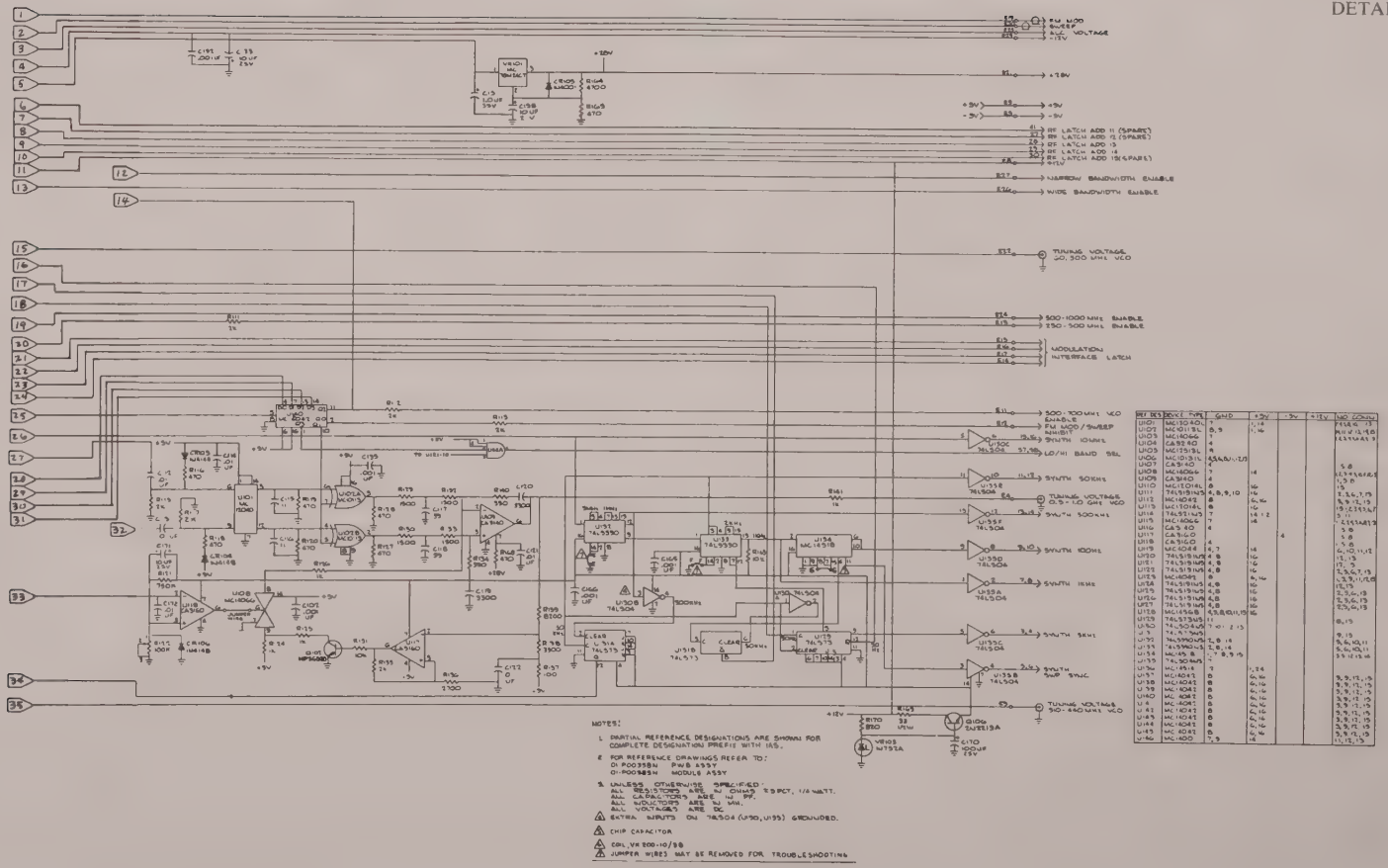
RF SYNTHESIZER
DIGITAL BOARD

MODEL RTC4009B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



NOTES:

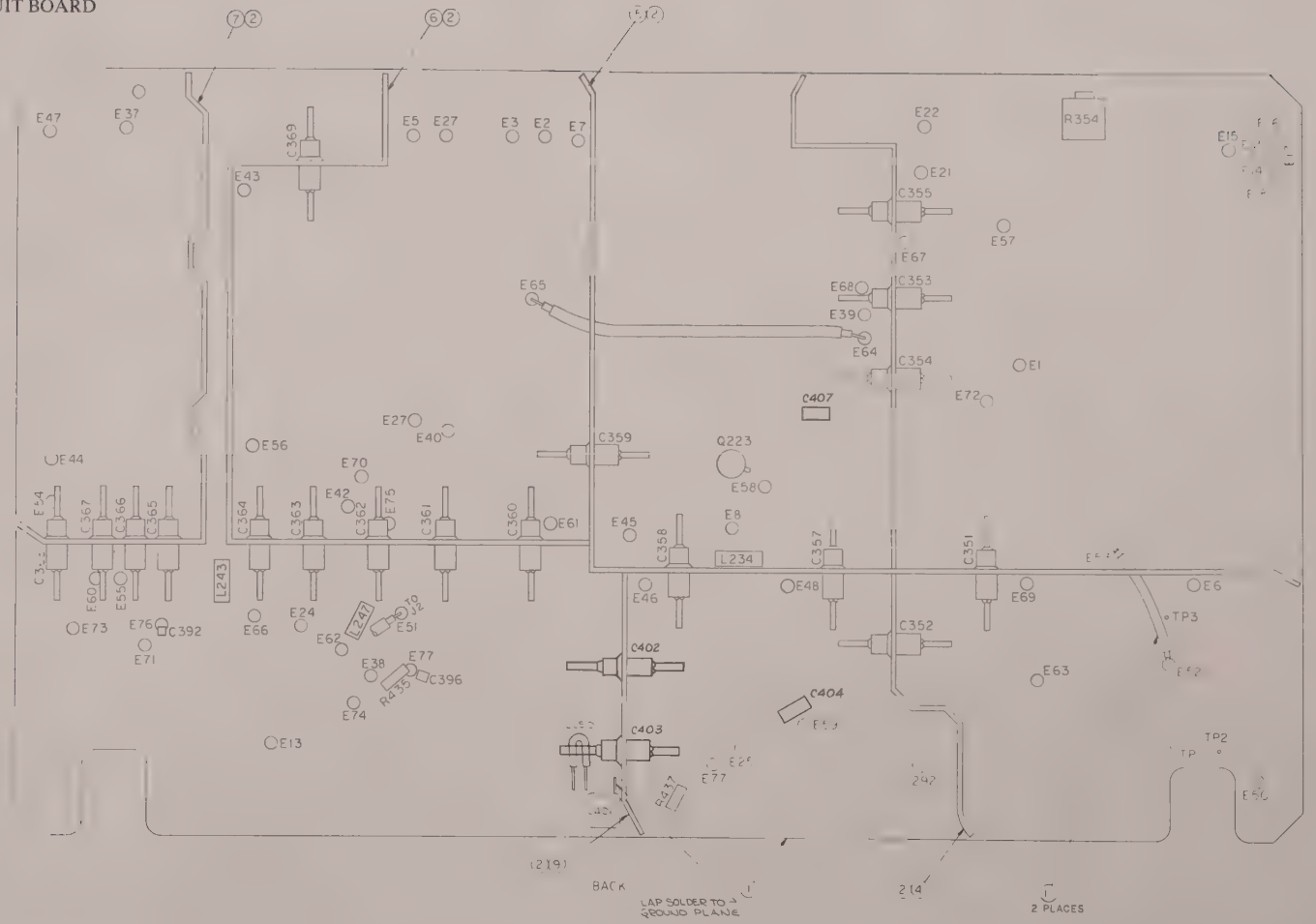
1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN FOR COMPLETE DESIGNATION PREFIX WITH 185.
2. FOR REFERENCE DRAWINGS REFER TO:
   01-P0039BN PWB ASSY
   01-P0098BN MODULE ASSY
3. UNLESS OTHERWISE SPECIFIED
   ALL RESISTORS ARE ½ OHMS ±5PCT, 1/8 WATT.
   ALL CAPACITORS ARE IN MFD OR PF.
   ALL VOLTAGES ARE +V UNLESS
   ALL VOLTAGES ARE DC
4. EXTRA INPUTS ON 74LS04 (U130, U135) GROUNDED.
5. CHIP CAPACITOR
6. COIL VK200-10/9B
7. JUMPER WIRES MAY BE REMOVED FOR TROUBLESHOOTING

REF DES	DEVICE TYPE	GND	+5V	-5V	+15V	NO CONN
U101	MC12040-1	7	14			1,2,3,4,5,6,8,9,10,11,12,13
U102	MC4011BL	8,9	14			
U103	MC4066	7				
U104	CA3240	4				
U105	MC1733L	4				
U106	MC1013L	4,5,8,11,12				
U107	CA3140T	4				5,8
U108	MC14066	7				1,2,3,4,5,6,8,9,10,11,12,13
U109	CA3140	4				1,3,8
U110	MC12018L	8	16			15
U111	74LS191N	4,8,9,10	16			1,2,4,7,15
U112	MC14042	8	16			3,9,11,13
U113	MC12018L	8	16			15,12,13,14,7
U114	74LS191N	7	16	12		3,11
U115	MC14066	7	14			1,2,3,4,8,12
U116	CA3140	4				1,3,8
U117	CA3140	4			4	1,3,8
U118	CA3140	4				1,3,8
U119	MC14042	4,7	16			6,10,11,12
U120	74LS191N	4,8	16			11,13
U121	74LS191N	4,8	16			12,2
U122	74LS191N	4,8	16			2,3,4,7,13
U123	MC14049	8	16			1,3,9,11,12,13
U124	74LS191N	4,8	16			12,13
U125	74LS191N	4,8	16			2,3,4,13
U126	74LS191N	4,8	16			2,3,4,13
U127	74LS191N	4,8	16			2,3,4,13
U128	MC14568	4,5,8,12,13,15	16			
U129	74LS73N	11				8,13
U130	74LS04N	7 10 12 13				
U131	74LS74N	7				9,13
U132	74LS90N	7,8,12				3,4,10,11
U133	74LS90N	7,8,12				3,4,10,11
U134	MC1458	4,7 8,9,13				3,5,12,13,14
U135	74LS04N	7				
U136	MC1514	7	24			
U137	MC4042	8	16			3,9,11,15
U138	MC4042	8	16			3,9,11,15
U139	MC4042	8	16			3,9,11,15
U140	MC 4042	8	16			3,9,11,15
U141	MC4042	8	16			3,9,11,15
U142	MC14042	8	16			3,9,11,15
U143	MC14042	8	16			3,9,11,15
U144	MC4042	8	16			3,9,11,15
U145	MC4042	8	16			3,9,11,15
U146	MC4002	7,8	14			1,11,13

RF SYNTHESIZER

RF BOARD

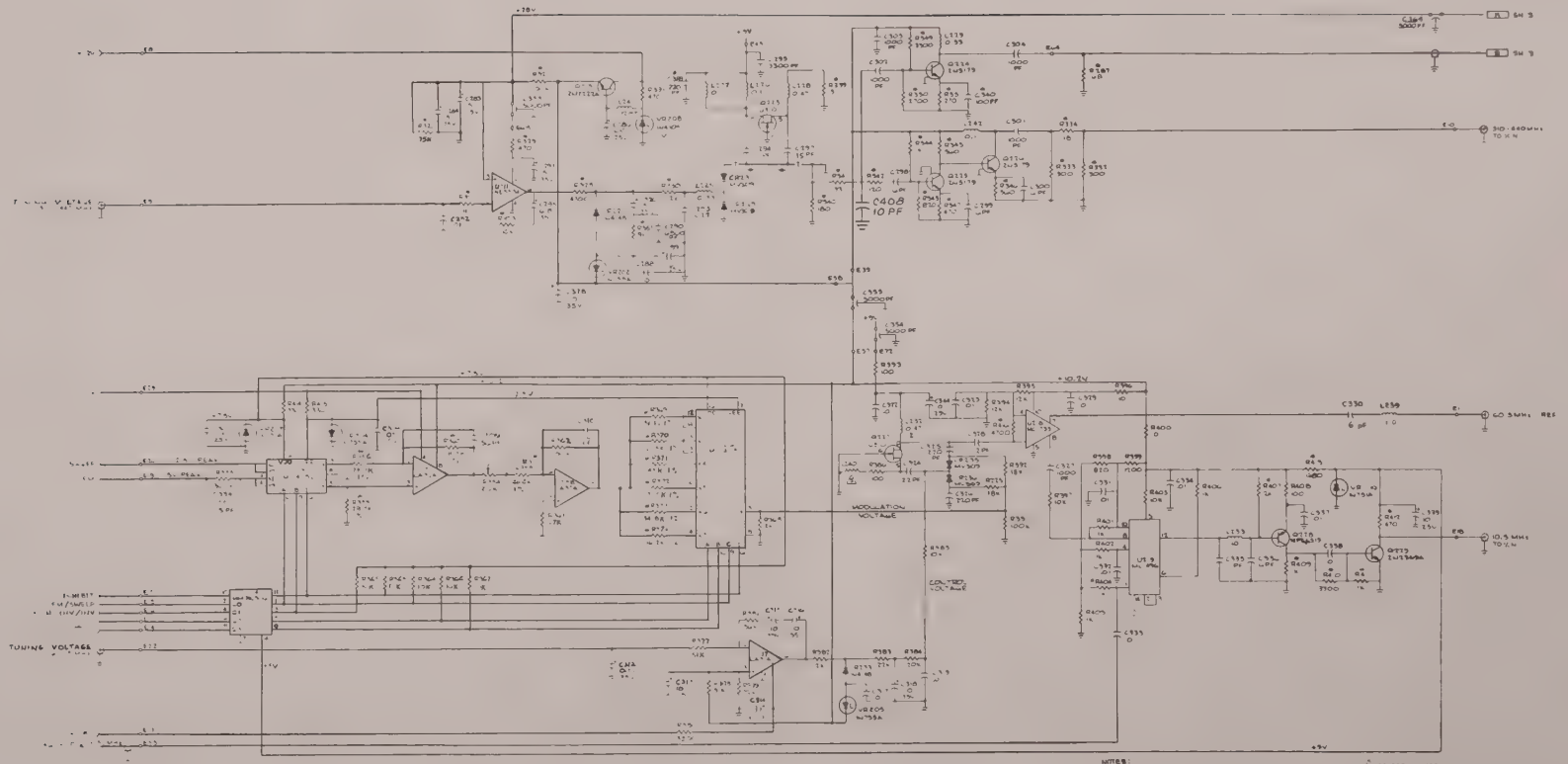
MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



RF SYNTHESIZER

RF BOARD

MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



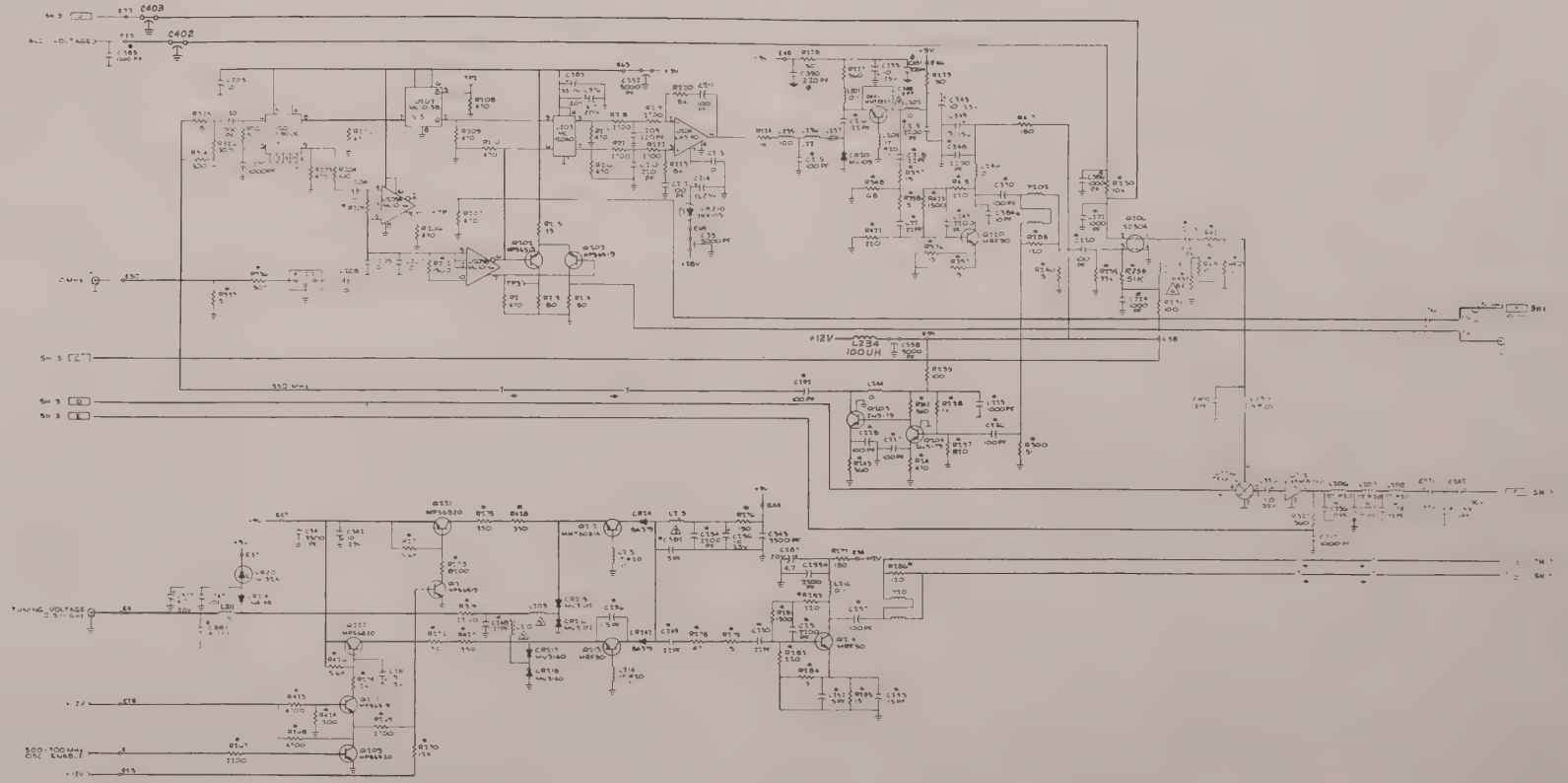
Motorola No. PEPS-37065-B
(Sheet 4 of 6)
4/1/84- PHI

RF SYNTHESIZER RF BOARD

RF SYNTHESIZER

RF BOARD

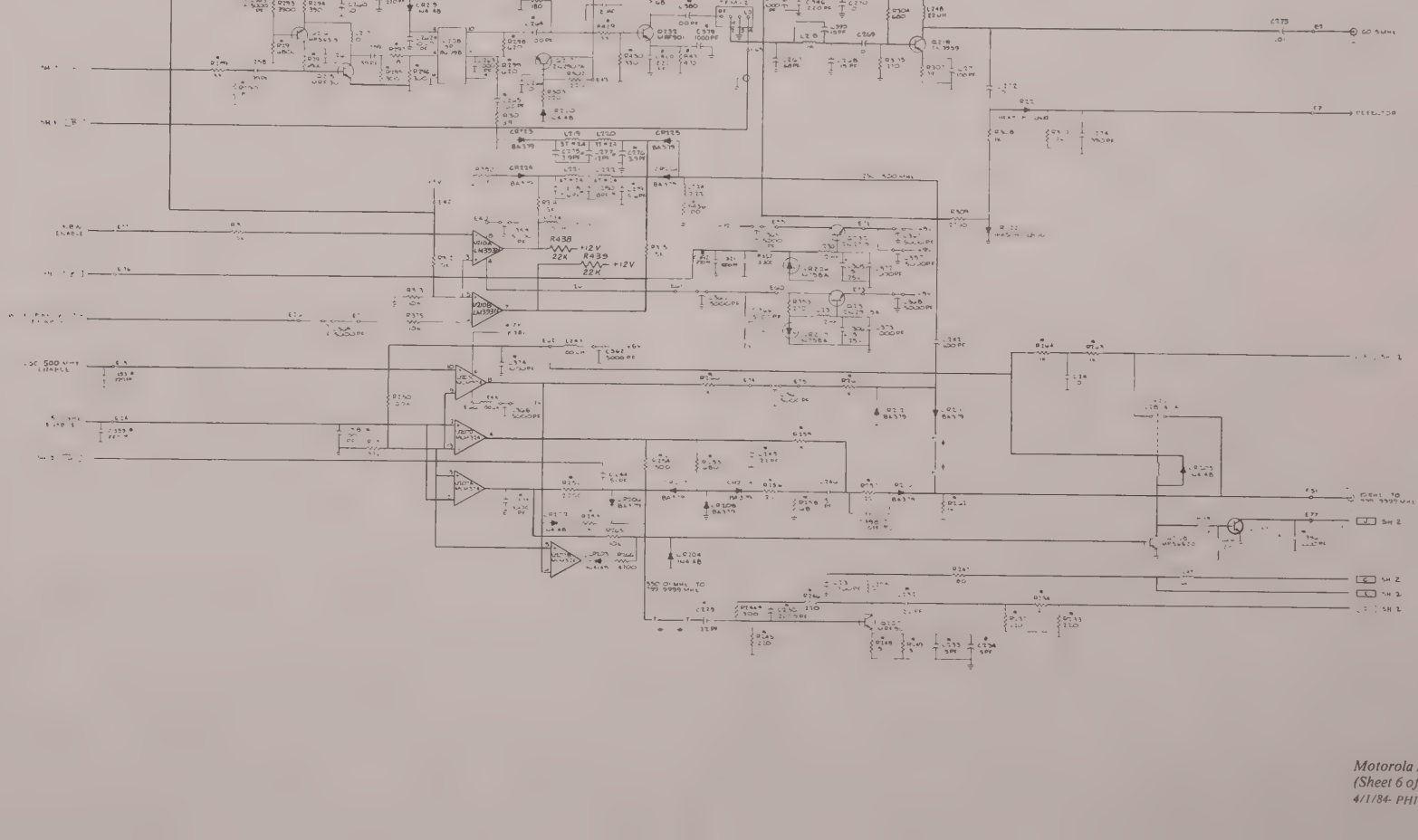
MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



RF SYNTHESIZER

RF BOARD

MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST



Motorola No. PEPS-37065-B
(Sheet 6 of 6)
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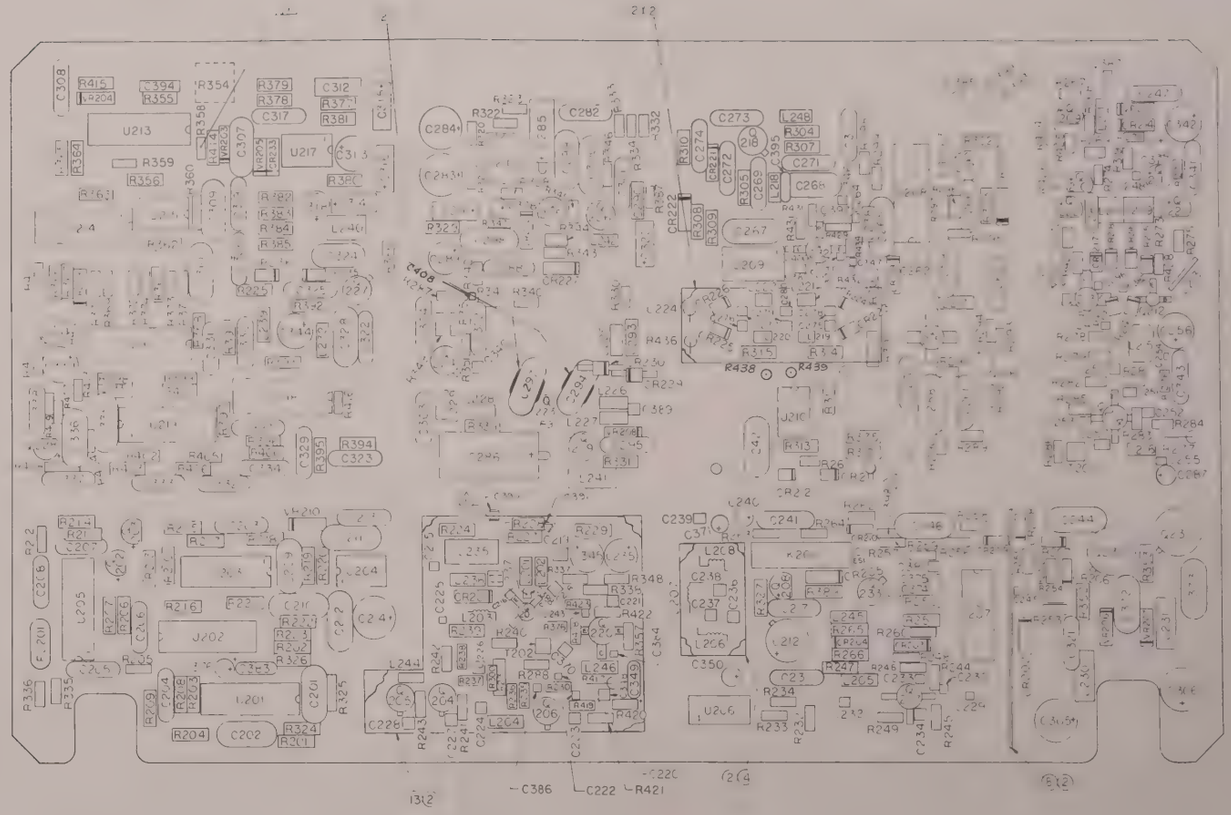
RF SYNTHESIZER
RF BOARD

MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST

NOTES:
1. VALUE OF COMPONENT TO BE SELECTED IN TEST.



Motorola No. PEPS-37065-B
(Sheet 2 of 6)
4 12 4- PHI

RF SYNTHESIZER
RF BOARD
MODEL RTC4010B
SCHEMATIC DIAGRAM, CIRCUIT BOARD
DETAIL, AND PARTS LIST

Motorola No. PEPS-37065-B
(Sheet 3 of 6)
4/1/84- PHI

parts list

RTC4010B RF Synthesizer RF Board — PL 8520-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor: pF ±10%; 100 V: unless otherwise stated
C201 202	21-82187B14	1000
C203 thru 208	21-82428B59	.01 uF + 80-10%, 200 V
C209 210	21-82187B08	220, 500 V
C211 212	21-84494B04	100 ± 5%, 500 V
C213	21-82428B59	.01 uF + 80-10%, 200 V
C214	23-84665F01	10 uF, 25 V
C215	21-80376A17	100, 50 V (chip)
C216	21-80376A10	22 ± 5%, 50 V (chip)
C217	21-82187B14	1000, 100 V
C218	21-80376A10	22 ± 50%; 50 V (chip)
C219	21-80376A26	2200, 50 V (chip)
C220	21-80376A17	100, 50 V (chip)
C221	21-80376A10	22 ± 5%, 50 V (chip)
C222	21-80376A25	1000, 50 V (chip)
C223	21-80376A17	100, 50 V (chip)
C224 225	21-80376A25	1000, 50 V (chip)
C226	21-80376A17	100, 50 V (chip)
C227 228 229	21-80376A10	22, 50 V (chip)
C230	21-80376A26	2200, 50 V (chip)
C231	21-82187B14	1000 100 V
C232	21-80376A10	22 ± 5%, 50 V (chip)
C233 234	21-80376A08	15 ± 5%, 50 V (chip)
C235	23-84665F01	10; 50 V (chip)
C236	21-80376A06	10 ± 5%, 50 V (chip)
C237 238	21-80376A10	22 ± 5%, 50 V (chip)
C239	21-80376A06	10; 50 V (chip)
C240	23-83441B15	1.0 uF ± 20%, 35 V
C241	21-82428B59	.01 uF + 80-20% 200 V
C242	21-84494B04	100 ± 5%, 500 V
C243	21-80376A26	2200, 50 V (chip)
C244	21-84494B01	51 ± 5%, 500 V
C245	21-80376A10	22 ± 5%, 50 V (chip)
C246	21-84494B01	51 ± 5%, 500 V
C247	21-82428B59	.01 uF + 80-20%, 200 V
C248	21-80376A11	27 ± 5%, 50 V (chip)
C249 250	21-80376A10	22 ± 5%, 50 V (chip)
C251	21-80376A26	2200, 50 V (chip)
C252, 253	21-80376A08	15 ± 5%, 50 V (chip)
C254 255	21-80376A26	2200, 50 V (chip)
C256	23-84665F01	10 uF, 25 V
C257	21-80376A17	100, 50 V (chip)
C258 259	21-84494B24	39 ± 5%, 500 V
C260 261	21-82428B59	.01 uF + 80-20%, 200 V
C262 263	21-80376A25	1000, 50 V (chip)
C264	21-80376A17	100, 50 V (chip)
C265	21-84494B04	100 ± 5%, 500 V
C266	21-82428B59	.01 uF + 80-20%, 200 V
C267	21-84494B34	68 ± 5%, 500 V
C268	21-859936	15 ± 5%, 500 V
C269 270	21-82428B59	.01 uF + 80-20%, 200 V
C271	21-84494B06	120 ± 5%, 500 V
C272 273	21-82428B59	.01 uF + 80-20% , 200 V
C274	21-865922	390, 500 V
C275 276	21-80376A03	3.9 ± 0.25%, 50 V (chip)
C277	21-80376A07	12 ± 5%, 50 V (chip)
C278 279	21-80376A05	5.6 ± 0.25%, 50 V (chip)
C280	21-80376A09	18 ± 5%, 50 V (chip)
C281	23-82397D04	15 uF ± 20%, 15 V
C282	21-80369A99	.01 uF
C283 284	23-84665F02	15 uF, 25 V
C285	23-80369A64	6.8 uF, 35 V
C286	23-84665F10	100 uF 25 V
C287	23-83441B18	4.7 uF ± 20% 20 V
C288	21-82428B59	.01 uF + 80-20% 200 V
C289	23-84665F01	10 uF 25 V
C290	21-80370A03	6800
C291	23-80368A62	15 uF ± 20% 35 V
C292	21-80376A17	100 ± 20% 50 V (chip)
C293	21-80370A04	.011 uF
C294	21-859934	10 ± 5%, 500 V
C295	21-82428B10	3300
C296	21-80376A01	1.5 ± 0.5 pF, 50 V (chip)
C297	21-859936	15 ± 5%, 500 V
C298	21-84494B47	6 ± 0.5 pF 500 V
C299 300	21-84494B74	6 ± 0.5 pF, 500 V
C301 thru 304	21-82187B14	1000
C305 306	23-84665F02	15 uF, 25 V
C307 308	21-82372C10	.05 uF ± 20% 25 V
C309	21-84494B45	56 ± 5%, 500 V
C310	21-84494B36	15 ± 5%, 500 V
C311	21-82187B14	1000
C312	23-82397D50	0.22 uF ± 20%, 35 V
C313	23-84665F01	10 uF, 25 V
C314, 315 316	23-80369A61	10 uF ± 20%, 35 V
C317	22 82428B59	01 uF + 80-20%, 200 V
C318	23-83441B15	1.0 uF ± 20%, 35 V
C319	21 82428B59	01 uF + 80-20% 200 V
C320	23-80369A62	15 uF ± 20%, 35 V
C321	21-82187B14	1000
C322 323	21-82428B59	01 uF + 80-20% 200 V
C324	21 80369A88	22 ± 5%, 500 V
C325, 326	21 82187B08	220, 500 V
C327	21-82187B14	1000
C328	21-80369A83	2 ± 0.5 pF, 500 V

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C329	21-82428B59	.01 uF + 80-20%, 200 V
C330	21-84494B74	6 ± 5%, 500 V
C331 thru 334	21-82428B59	.01 uF + 80-20%; 200 V
C335	21-84494B37	11 ± 5%, 500 V
C336	21-84494B74	6 ± 0.5 pF, 500 V
C337, 338	21-82428B59	.01 uF + 80-20%, 200 V
C339	23-84665F01	10 uF, 25 V
C340	21-80376A17	100; 50 V (chip)
C341	21-82428B10	3300
C342	23-84665F01	10 uF, 25 V
C343	21-82428B10	3300
C344, 345	23-84665F01	10 uF, 25 V
C346, 347	21-83076A18	220; 50 V (chip)
C348	21-80376A26	2200; 50 V (chip)
C349	23-82397D04	15 uF ± 20%; 15 V
C350	23-83441B15	1.0 uF ± 20%, 35 V
C351 thru 369	21 82543H03	5000 + 80-20%, 500 V
C370	21-80376A17	100, 50 V (chip)
C371	23-83441B15	1.0 uF ± 20%, 35 V
C372 373	21-82187B14	1000
C374 375	21-80376A25	1000, 50 V (chip)
C376, 377	23 83441B18	4.7 uF ± 20%, 20 V
C378	23-83441B15	1.0 uF ± 20%, 35 V
C379	21-80376A25	1000, 50 V (chip)
C380	21-80376A17	100; 50 V (chip)
C381	21-80376A25	1000, 50 V (chip)
C382	21-80376A01	1.5 ± 0.5 pF, 50 V (chip)
C383	23-82397D18	33 uF ± 20%; 10 V
C384	21-80376A06	10 ± 5%, 50 V (chip)
C385 386	21 80376A25	1000, 50 V (chip)
C387	21-80376A04	4.7 ± 0.5 pF, 50 V (chip)
C388	21-80376A01	1.5 ± 0.5 pF, 50 V (chip)
C389	21 80376A14	220 ± 2%, 50 V (chip)
C390 thru 393	21 80376A18	220, 50 V (chip)
C394, 395	21 859936	15 ± 5%, 500 V
C396	21-80376A25	1000, 50 V (chip)
C397	21-80369A83	2 ± 0.5 pF, 500 V
C398	21-8711966	10, 200 V
	or 21-859934	5 ± 0.5 pF, 500 V
C399, 400	21-80376A18	220; 50 V (chip)
C401	21-871966	5, 500 V
C402 403	21-82546J03	5000 + 80-20%, 500 V
C404	21 80376A17	100, 50 V (chip)
C407	21 80376A01	15, 50 V (chip)
C408	21-80376A75	10; 50 V (chip)
C500	21-80376A18	22, 50 V (chip)
C501	21-80376A06	10, 50 V (chip)
		diode
CR201	48 82190H32	varactor
CR202 thru 205	48-82617C01	silicon
CR206 thru 212	48 80345A62	silicon
CR214	48-82617C01	silicon
CR215 216	48-82190H47	varactor
CR217 218	48 82190H37	varactor
CR219, 220	48-82617C01	silicon
CR221 222	48-84616A01	hot carrier
CR223 thru 226	48 80345A62	silicon
CR227	48-82617C01	silicon
CR229, 230	48-80397A25	varactor
CR233	48-82617C01	silicon
CR235, 126	48-80397A25	varactor
CR241 242	48-80345A62	silicon
		filter, crystal:
FL201	91 80378A36	10 MHz, 2-pole
		relay:
K201	80-80346A02	
		coil:
L201 202	24-80369A19	0.1 uH
L203	24-80369A50	air wound, 1T 20
L204 205	24-80369A19	0.1 uH
L206, 207, 208	24 80369A49	air wound, 1T 20
L209, 210	24 80369A01	choke, rf
L211	24 80369A23	0.15 uH ± 10%
L213 214	24-80369A50	air wound, 1T 20
L215	24 80361B01	choke rf
L216 217	24 80369A19	0.1 uH
L218	24 80369A24	0.18 uH
L219, 220	24 80369A48	air wound, 3T 24
L221, 222	24-80369A51	air wound, 4T 24
L224	24 80369A25	0.22 uH
L225	24 80369A26	0.33 uH
L226, 227	24 80369A19	0.1 uH
L228	24 80369A27	0.47 uH
L229	24 80369A26	0.33 uH
L230, 231	24-80370A39	inductor, 12 mH
L232	24 80369A14	0.47 uH ± 1%
L233	24-80369A29	10 uH
L234, 235	24-80369A37	100 uH
L236	24 80369A25	0.22 uH
L237	76-83608B01	bead, ferrite
L238	24-80369A23	0.15 uH ± 10%
L239	24 80369A22	1 uH ± 10%
L240	24-83961B01	choke, rf
L241	24 80370A39	inductor, 12 mH
L242	24-80369A19	0.1 uH

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
L243	24-80369A37	100 uH
L244, 245, 246	24-80369A19	0.1 uH
L247	24-80369A37	100 uH
L248	24-80369A31	22 uH
L250	24-80369A52	
		transistor:
Q201	48-80345A46	NPN
Q202, 203	48-869571	PNP; type M9571
Q204, 205	48-84309A61	NPN
Q206	48-80345A54	dual gate MOSFET
Q207	48-869570	NPN, type MRF901
Q208, 209	48-869570	NPN, type M9570
Q210 211	48-869571	PNP, type M9571
Q212	48-80345A47	NPN
Q213, 214, 215	48-869870	NPN;type MRF901
Q216	48-869571	PNP; type M9571
Q217	48-84123A22	PNP
Q218	48-80346A65	NPN
Q219	48-2089C01	NPN
Q220	48-869870	NPN, type MRF901
Q221, 222	48-869570	NPN, type M9570
Q223	48-869933	N-channel FET, type U310
Q224 225, 226	48-84309A61	NPN
Q227	48-869933	N-channel FET; type U310
Q228	48-869571	PNP; type M9571
Q229	48-84308A92	NPN
Q230	48-86851C32	NPN
Q231	48-80378A38	PNP
Q232	48-869870	NPN, type MRF901
Q233	48-2089C01	NPN
		resistor: ±5%; 1/4 W: unless otherwise stated
R201	6-124A18	51
R202, 203	6-124A41	470
R204	6-124A25	100
R205	6-185A25	100; 1/8 W
R206 thru 211	6-124A41	470
R212	6-185A53	1.5k; 1/8 W
R213, 214	6-124A31	180
R215	6-124A15	39
R216, 217	6-124A41	470
R218, 219	6-124A59	2.7k
R220	6-124A79	18k
R221, 222	6-124A59	2.7k
R223	6-124A79	18k
R224	6-124A49	1k
R225	6-124A79	18k
R227	6-124A43	560
R228, 229	6-124A29	150
R230	6-185A73	10k; 1/8 W
R231	6-124A25	100
R232, 233	6-185A33	220; 1/8 W
R234	6-185A09	22; 1/8 W
R235	6-185A85	33k, 1/8 W
R236	6-185A96	51k; 1/8 W
R237	6-185A47	820; 1/8 W
R238	6-185A49	1k; 1/8 W
R239	6-124A25	100
R240	6-185A18	51; 1/8 W
R241	6-185A41	470; 1/8 W
R242, 243	6-185A43	560; 1/8 W
R244	6-185A53	1.5k; 1/8 W
R245, 246	6-185A33	220; 1/8 W
R247	6-124A31	180
R248, 249	6-185A05	15, 1/8 W
R250	6-124A97	100k
R251	6-124A85	33k
R252	6-185A57	2.2k; 1/8 W
R253	6-185A49	1k; 1/8 W
R254	6-185A53	1.5k, 1/8 W
R255	6-185A45	680, 1/8 W
R256, 257	6-185A09	22; 1/8 W
R258	6-185A21	68; 1/8 W
R259 thru 264	6-185A49	1k, 1/8 W
R265	6-124A73	10k
R266	6-124A65	4.7k
R267	6-185A57	2.2k; 1/8 W
R268	6-185A65	4.7k, 1/8 W
R269	6-185A59	2.7k, 1/8 W
R270	6-185A75	12k; 1/8 W
R271	6-185A67	5.6k, 1/8 W
R272	6-185A29	150; 1/8 W
R273	6-185A71	8.2k; 1/8 W
R274	6-185A75	12k; 1/8 W
R275	6-185A37	330; 1/8 W
R276	6-185A29	150; 1/8 W
R277	6-124A31	180
R278	6-185A17	47; 1/8 W
R279	6-185A05	15; 1/8 W
R281	6-185A53	1.5k; 1/8 W
R282, 283	6-185A33	220; 1/8 W
R284, 285	6-185A05	15; 1/8 W
R286	6-185A27	120; 1/8 W

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R287	6-185A21	68, 1/8 W
R288	6-185A27	120, 1/8 W
R289	6-185A13	33, 1/8 W
R290	6-185A07	18; 1/8 W
R291, 292	6-185A69	8.8k, 1/8 W
R293	6-185A63	3.9k, 1/8 W
R294	6-185A39	390, 1/8 W
R295, 296	6-185A36	300 1/8 W
R297	6-185A07	18; 1/8 W
R298, 299	6-185A44	620, 1/8 W
R300	6-185A18	51; 1/8 W
R301	6-124A15	39
R302 303	6-124A33	220
R304	6-124A45	680
R305	6-124A35	270
R307	6-124A15	39
R308	6-124A49	1k
R309	6-124A59	2.7k
R310 thru 313	6-124A73	10k
R314 315	6-124A53	1.5k
R319	6-185A57	2.2k, 1/8 W
R320	6-185A84	75k, 1/8 W
R321	6-185A97	100k 1/8 W
R322	6-185A49	1k, 1/8 W
R323	6-185A73	10k, 1/8 W
R324	6-124A36	300
R325	6-124A07	18
R326	6-124A36	300
R327	6-124A43	560
R328	6-185A65	4.7k, 1/8 W
R329	6-185A41	470
R330	6-185A75	12k, 1/8 W
R331	6-124A41	470
R332, 333	6-185A36	300, 1/8 W
R334	6-185A07	18, 1/8 W
R335	6-185A18	51, 1/8 W
R336	6-185A53	1.5k, 1/8 W
R337 338	6-185A05	15; 1/8 W
R339	6-185A18	51
R340	6-185A31	180, 1/8 W
R341	6-185A13	33; 1/8 W
R342	6-185A27	120; 1/8 W
R343	6-185A47	820; 1/8 W
R344	6-185A49	1k, 1/8 W
R345 346	6-185A43	560, 1/8 W
R347	6-185A41	470; 1/8 W
R348	6-185A21	68, 1/8 W
R349	6-185A61	3.3k, 1/8 W
R350	6-185A59	2.7k, 1/8 W
R351	6-185A35	270; 1/8 W
R352	6-124A61	3.3k
R353	6-124A35	270
R354	18-83452F16	variable, 20k
R355	6-82672B33	309 ± 1%
R356	6-124A83	27k
R357	6-185A05	15, 1/8 W
R358	6-10621D56	46.4k ± 1; 1/8 W nominal
	or 6-10621D48	38.3k ± 1%, 1/8 W
	or 6-10621D52	42.2k ± 1%, 1/8 W
	or 6-10621D60	51.1k ± 1%, 1/8 W
	or 6-10621D64	56.2k ± 1%, 1/8 W
	or 6-10621D68	61.9k ± 1%, 1/8 W
R359, 360	6-10621D38	28.7k ± 1%, 1/8 W
R361	6-124A83	27k
R362	6-124A97	100k
R363 thru 367	6-124A73	10k
R368	6-124A56	2.0k
R369	6-10621D60	51.1 ± 1%, 1/8 W
R370	6-10621C27	2150 ± 1%; 1/8 W
R371	6-10621E04	143k ± 1%; 1/8 W
R372	6-10621D74	71.5k ± 1%; 1/8 W
R373	6-10621D44	34.8k ± 1%, 1/8 W
R374	6-10621D12	16.2k ± 1%, 1/8 W
R375	6-124A73	10k
R376	6-185A05	15; 1/8 W
R377	6-124A59	51k
R378	6-124A98	91k
R379	6-124A81	22k
R380	6-124A61	3.3k
R381	6-124A91	56k
R382	6-124A56	2.0k
R383	6-124A81	22k
R384	6-124A99	120k
R385	6-124A73	10k
R386	6-124A23	100
R387	6-185A24	91; 1/8 W
R389	6-124A73	10k
R390	6-124A25	100
R391	6-124A97	100k
R392	6-124A79	18k
R393	6-124A25	100
R394, 395	6-124A75	12k
R396	6-124A01	10
R397	6-124A73	10k
R398	6-124A47	820

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R399	6-124A51	1.2k
R400	6-124A01	10
R401, 402, 403	6-124A49	1k
R404	6-185A49	1k, 1/8 W
R405	6-124A73	10k
R406	6-124A49	1k
R407	6-185A58	2.0k; 1/8 W
R408	6-124A25	100
R409	6-185A49	1k; 1/8 W
R410	6-185A61	3.3k, 1/8 W
R411	6-185A49	1k; 1/8 W
R412	6-185A41	470; 1/8 W
R413	6-185A45	680, 1/8 W
R414, 415	6-124A37	330
R416	6-185A65	4.7k, 1/8 W
R417	6-124A31	180
R418	6-185A33	220, 1/8 W
R419, 420	6-185A31	180, 1/8 W
R421	6-185A85	33, 1/8 W
R422	6-185A33	220, 1/8 W
R423	6-185A53	1.5k, 1/8 W
R424	6-185A51	1.2k, 1/8 W
R425	6-185A65	4.7k; 1/8 W
R426	6-185A67	5.6k 1/8 W
R427 thru 430	6-185A37	330; 1/8 W
R431	6-185A41	470, 1/8 W
R432	6-185A21	68; 1/8 W
R434	6-185A31	180; 1/8 W
R435	6-124A56	2.0k
R436	6-185A25	100, 1/8 W
R437	6-185A23	82; 1/8 W
R438	6-124A81	22k
R439	6-124A81	22k
R500, 501	6-124A81	22k
R502	6-124A25	100
		transformer:
T201, 202	24-80369A53	2T 32 on 3B bead
		integrated circuit:
U201	51-80365A18	650 MHz prescaler
U202	51-80365A06	bi-quinary counter
U203	51-80365A01	phase frequency detector
U204	51-83629M07	operational amplifier
U205	51-80365A02	triple line receiver
U206	1-84848M02	mixer
U207	51-83629M08	operational amplifier
U208	51-80345A32	high speed 1.3 GHz divider
U209	1-84848M02	mixer
U210	51-80365A26	operational amplifier
U211	51-80365A14	micro circuit; NE5534AN screened low noise operational amplifier
U212	51-80346A54	dc; 600 MHz wideband hybrid amplifier
U213	51-82884L54	dual 4-channel analog multiplexer/demultiplexer
U214	51-84561L97	hex open drain N-channel buffer
U215	51-80365A07	operational amplifier
U216	51-84884L76	8-channel analog multiplexer/demultiplexer
U217	51-83629M07	operational amplifier
U218	51-80365A15	differential video wideband amplifier
U219	51-83222M05	balanced modulator/demodulator
		Zener diode: ±5%; 1/4 W: unless otherwise stated
VR201	48-83193A59	5.6 V
VR202 thru 205	48-82256C44	7.5 V
VR206, 207	48-82256C11	10 V
VR208	48-82256C34	11 V
VR209	48-86850C13	5.1 V
VR210	48-82256C34	11 V

REF. NO.	MECHANICAL PARTS	
	RTC-4010B	RF synthesizer
1	84-80335A21	PWB, rf synthesizer
2	SN636WRMAP3	SOLDER
3	11-141674O1	INK, BLK
4	26-P00210N001	SHIELD
5	26-P00210N02	SHIELD
6	26-P00210N03	SHIELD
7	26-P0021N004	SHIELD
8	26-P0021N005	SHIELD
9	26-P00210N08	SHIELD
11	1-80335A61	CABLE, semi-rigid
12	26-P00210N007	SHIELD, can
13	26-P00240N001	SHIELD, can
14	26-P00210N008	SHIELD, can
15	SN63WRP3	SOLDER
16	M23053/5-103-9	INSULATOR SLEEVING, .093 WHT
17	M23053/5-205-C	INSULATION SLEEVING, 0.187 CLR
18		INSULATION SLEEVING, 22 WHT
19		INSULATION TAPE, 1 IN YEL
20		WIRE, 24

REF. NO.	MOTOROLA PART NO.	DESCRIPTION
21	RTV3145	ADHESIVE
22		WIRE, teflon 22 solid WHT
23		INSULATING SLEEVING 14WHT
24	SN62WRMAP3	SOLDER

RECEIVER BOARD
MODEL RTL4134B

1. DESCRIPTION

1.1 The receiver demodulates and processes the 10.7 MHz i-f output from the rf module to recovered AM and FM audio signals. The receiver consists of an i-f section, an audio section, a squelch section, frequency counter output circuit, and a microprocessor interface.

1.2 Input signals are subjected to filtering, amplification, limiting, detection, and AGC control. Primary outputs from the receiver board include calibrated audio levels corresponding to deviation and percent of amplitude modulation. A gated 10.7 MHz i-f signal is output to the counter circuits to determine frequency error. The amplifiers in the i-f section are AGC controlled to establish overload alarm signals. Squelch status is applied to the front panel for monitoring. All switching on the receiver is microprocessor-controlled via the data bus.

1.3 RF from the wideband amplifier is applied via coaxial cable to J1 on the receiver board. The recovered audio is applied to the output via the main interconnect board.

2. THEORY OF OPERATION

2.1 I-F SECTION

2.1.1 General

The i-f section consists of an AGC controlled amplifier, AGC circuit, AM i-f and detector circuit, FM i-f and quadrature detector circuit, and bandpass filtering. The output from the rf module is connected via coaxial cable to J1. Amplifier U1 is an AGC controlled input amplifier that is matched to the narrow bandpass and wide bandpass filter. U1 gain is determined by the output of U6A. Narrowband or wideband filtering is selected by the i-f bandwidth control lines. The FM i-f signal is sent to the FM i-f circuit and quadrature detector U2 where it is converted into audio.

2.1.2 AGC Controlled Amplifier

I-F input amplifier U1 is an AGC controlled amplifier. The i-f cirucit is terminated through J1 by a 50 ohm load. The output of U1 is a 4000 ohm tuned circuit and matched filter.

2.1.3 AGC Circuit

The dc component of the composite AM signal is applied to amplifier U6A where it is amplified and sent to amplifier U1 as the AGC voltage. Feedback circuitry and filtering provide sufficient time for the AGC circuit to respond to changes in signal level inherent with AM signals.

2.1.4 AM I-F and Detector

AM i-f signals are routed through transistor circuits utilizing a high input impedance to avoid loading the i-f filter output. AM detection is accomplished by diode CR13 with the composite signal being developed across C48 and R54.

2.1.5 FM I-F and Quadrature Detector Circuit

The output of the i-f filter is applied to U2. The amplifier combines both amplifier, limiter, and quadrature detector on a single integrated circuit. The tuned network from pin 8 to pin 10 supplies a quadrature i-f signal. The i-f signal and quadrature component are applied to the internal detector of U2. The audio output is sent to audio amplifier U8B.

2.2 AUDIO/SQUELCH SECTION

Composite AM from the AM detector is sent through a 7 kHz low-pass filter prior to being amplified by U9B. The AM audio signal is applied to amplifier U5A where it is amplified and applied to the percent modulation output. AM audio is also applied to gate U7C and is routed through the active filter U12B. If FM select is active, the FM audio signal from amplifiers

U8B and U9A is routed through squelch gate U7C and U7D to the active filter.

2.3 AUDIO/COUNTER SECTION

The audio section consists of an audio inverter and an audio output amplifier. Audio is inverted by U12A. Switching for inversion is determined by U10A, U10B, and U10C. Audio is buffered by transistors Q8 and Q9 before being applied to the output as recovered audio. The i-f signal from amplifier Q7 is buffered by transistor Q10 before being routed off the board as a 10.7 MHz signal. U6B and U16A determine at what input level the 10.7 MHz output is to be enabled. Transistor 11 enables CR18 to open the 10.7 MHz output line. AGC output from amplifier U6A is inverted by U4A. Squelch comparator U4B applies the squelch gate signal and the signal level voltage to light the front panel indicator.

2.4 INTERFACE SECTION

The interface section consists of anaddress decoder, data latch, and i-f bandwidth control line switch. The address decoder receives address input on AØ through A3 address lines and applies a data strobe to data latch U14. The data strobe gates data from data lines DØ through D3 into U14 to generate AM/FM select, audio invert, and i-f bandwidth gain signals. The i-f bandwidth control line switch applies narrow band or wideband select signals to the i-f input audio amplifier and filter circuit.

parts list

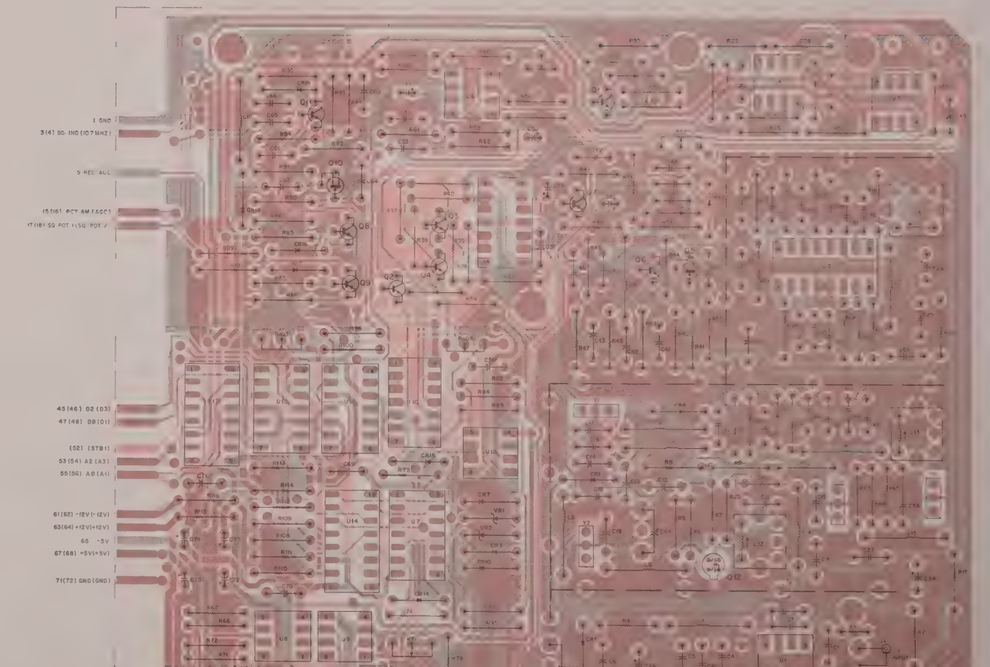
RTL4134B Receiver Board — PC 8698 A

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		capacitor, fixed: uF: ± 5%; 500 V; unless otherwise stated
C1 thru 7	21-83596E21	.01 + 80-20%; 200 V
C8		NOT USED
C9 thru 12	21-83596E21	.01 + 80-20%; 200 V
C13	21-83406D81	20 pF
C14	21-83406D03	16 pF ± 5%
C15	21-850118	100 pF; 5%
C16, 17, 18	21-83596E21	.01 + 80-20%; 200 V
C19	21-83406D68	27 pF ± 5%
C20	21-83596E21	.01 + 80-20%; 200 V
C21		NOT USED
C22 23	21-83596E21	.01 + 80-20%; 200 V
C24 25	21-82271C07	.05 + 80-20%; 25 V
C26	21-84665F26	100 + 20%; 16 V
C27	21-84665F21	.01 + 80-20%; 200 V
C28	21-84665F26	100 + 20%; 16 V
C29	21-82272C07	.05 + 80-0%; 25 V
C30, 31, 32	21-83596E21	.01 + 80-20%; 200 V
C33	21-850118	100 pF sil mica, 300 V
C34	21-84665F26	100 + 20%; 16 V
C35 36	21-84665	22 uF + 100-10%; 25 V
C37 thru 43	21-81596E21	.01 + 80-20%; 200 V
C44	20-82399D05	variable; 9-35 pF
C45, 46, 47	21-83596E21	.01 + 80-20%; 200 V
C48	21-84426B82	150 pF sil mica ± 5%; 300 V
C49	21-859144	300 pF sil mica ± 5%; 300 V
C50	23-84665F04	1 + 150-10%; 50 V
C51	23-84606L01	2.2 + 20%; 50 V
C52, 53	21-83596E21	.01 + 80-20%; 200 V
C54	53-84606L01	2.2 + 20%; 50 V
C55	8-82909G07	0.1 + 10%; 250 V
C56	21-82450B48	0.75 pF
C57	21-84426B30	240 pF sil mica ± 5%; 300 V
C58	21-847091	80 pF; sil mica ± 5%
C59	21-84426B08	100 pF sil mica ± 5%; 300 V
C60		NOT USED
C61 thru 65	21-83596E21	.01 + 80-20%; 200 V
C66 thru C68	21-83596E21	.01 + 80-20%; 200 V
C69, 70, 71	21-82272C04	.05 + 80-0%; 25 V
C72 thru 75	23-84665F01	10 + 100-10%; 25 V
C76, 77	21-83596E21	.01 + 80-20%; 200 V
C78, 79	23-84665F01	10 + 100-10%; 25 V
C80	21-83596E21	.01 + 80-20%; 200 V
C81	21-83406D86	47 pF ± 5%; 300 V
C82	20-82399D05	variable; 9-35 pF
C83	21-83406D67	22 pF
C84	21-83596E21	.01 + 80-20%; 200 V
		diode: (see note 1)
CR1	48-83654H01	silicon
CR2		NOT USED
CR3, 4, 5	48-83654H01	silicon
CR6		NOT USED
CR7 thru 10	48-83654H01	silicon
CR11		NOT USED
CR12 thru 20	48-83654H01	silicon
		connector, receptacle:
J1	9-83250M01	female; single contact (phono)
		coil, rf:
L1	24-84250D01	choke; 15 uH ± 5%
L2	24-82549D25	choke; 10 uH ± 5%
L3	24-82549D36	choke; 4.7 uH ± 10%
L4	24-84250D01	choke; 15 uH ± 5%
L5	24-82549D25	choke; 10 uH ± 5%
L6	24-82549D36	choke; 4.7 uH ± 10%
L7	24-82723H35	choke, 23 uH ± 10%
L8	24-83541L02	discriminator coil
L9, 10	24-82549D28	choke; 10 uH ± 20%
L11	24-84250D01	choke; 15 uH ± 5%
L12, 13	24-83541L02	tuneable coil
L14	24-82549D28	10 uH ± 20%
L15	24-82549D25	10 uH ± 5
		transistor: (see note 1)
Q1 thru 4	48-869570	NPN; type M9570
Q5	48-869940	field-effect, type M9940
Q6, 7, 8	48-869570	NPN; type M9570
Q9	48-869571	PNP; type M9571
Q10	48-869940	field-effect, type M9940
Q11	48-869570	NPN; type M9570
Q12	48-869791	field-effect; type M9791
		resistor, fixed: ± 5%; 1/4 W; unless otherwise stated
R1	6-124A18	51
R2,3	6-124A66	5.1k
R4	6-124A05	15
R5	6-124A68	6200
R6	6-124A37	330
R7	6-124A25	100
R8	6-124A73	10k
R9	6-124A79	18k

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
R10	6-124A56	1.8k
R11	6-124A45	680
R12	6-124A13	33
R13	6-124A09	22
R14, 15	6-124A97	100k
R16	6-124A85	33k
R17	6-124A07	18
R18	6-124A77	15k
R19	6-124A13	33
R20	6-124A87	5.6k
R21	6-124A70	7.5k
R22	6-124A35	270
R23	6-124A72	9.1
R24 25	6-124A97	100k
R26 27 28 29	6-124B02	150k
R30	6-124A45	680
R31	6-124A89	6.8k
R32	6-124A73	10k
R33	6-124A47	820
R34	6-124A89	47k
R35 36 37	6-124A81	27k
R38	6-124A96	36k
R39	6-124A8J	27k
R40	6-124A88	36k
R41	6-124A97	100k
R42	6-124A37	330
R43	6-124A73	10k
R44	6-124A71	8.2k
R45	6-124A51	1.2k
R46	6-124A78	16k
R47	6-124A58	2.7k
R48	6-124A49	1k
R49	6-124A31	180
R50	6-124A01	10
R51	6-124A73	10k
R52		NOT USED
R53	6-124A01	10
R54	18-83452F17	variable; 50k
R55	6-124A94	75k
R56	6-124B14	470k
R57	6-124A81	22k
R58	6-124A97	100k
R59	18-83452F14	variable; 10k
R60	6-124A49	1k
R61	6-124A09	22
R62	6-124A61	3.3k
R63	6-124A77	15k
R64	6-124A49	1k
R65	6-124A77	15k
R66	6-124A82	24k
R67	6-124A90	51k
R68	6-124A81	22k
R69	6-124A93	68k
R70		NOT USED
R71	6-124A68	6.2k
R72	6-124B06	220k
R73, 74	6-124A73	10k
R75	18-83452F20	variable; 100k
R76	6-124A85	33k
R77	18-83452F19	variable; 100k
R78	6-124A96	91k
R79	6-124A19	56
R80		NOT USED
R81, 82	6-124A92	62k
R83, 84	8-84640C14	127k ± 1%
R85	6-124A25	100
R86, 87	6-124A72	9.1k
R88	6-124A25	100
R89	6-124A09	22
R90	6-124A93	68k
R91	6-124A37	330
R92	6-124A01	10
R93	6-124A77	15k
R94	6-124A45	680
R95	6-124A89	47k
R96	6-124A59	2.7k
R97	6-124B14	470k
R98	6-124A44	620
R99	6-124A97	100k
R100	6-124A57	2.2k
R101, 102	6-124B06	220k
R103	18-83452F13	variable; 10k
R104		NOT USED
R105, 106	8-124A77	15k
R107	6-124B02	150k
R108 thru 112	6-124A71	8.2k
R113, 114	6-124A87	5.6k
R115, 116	6-124A01	10

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		integrated circuit: (see note)
U1	51-80066C01	i-f amplifier
U2	51-84561L84	quad detector
U3	51-82884L48	quad bilateral switch
U4	51-84371K63	dual operational amplifier
U5, 6	51-80365A07	dual operational amplifier
U7	51-82884L48	quad bilateral switch
U8, 9	51-80365A07	dual operational amplifier
U10	51-82884L48	quad bilateral switch
U11		NOT USED
U12	51-80365A07	dual operational amplifier
U13		NOT USED
U14	51-82884L15	quad compound D-latch
U15, 16	51-84371K74	quad comparator
U17	51-84561L42	quad 1-of-4 multiplexer/demultiplexer
		thermistor:
RT1	8-80312B81	9.1k, 10%
		voltage regulator: (see note)
VR1, 2	48-82256C46	Zener type ±5% - 3.9 V
		crystal: (see note)
Y1	91-80377A94	ceramic filter
Y2, 3, 4	91-80397A29	crystal filter
		mechanical parts
	3-139012	SCREW, machine; 4-40 x 1/4"; 7 used
	14-84602X02	INSULATOR
	26-80378A52	SHIELD
	45-80395A40	ACTUATOR, ejector; 2 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



SHOWN FROM COMPONENT SIDE

RECEIVER BOARD

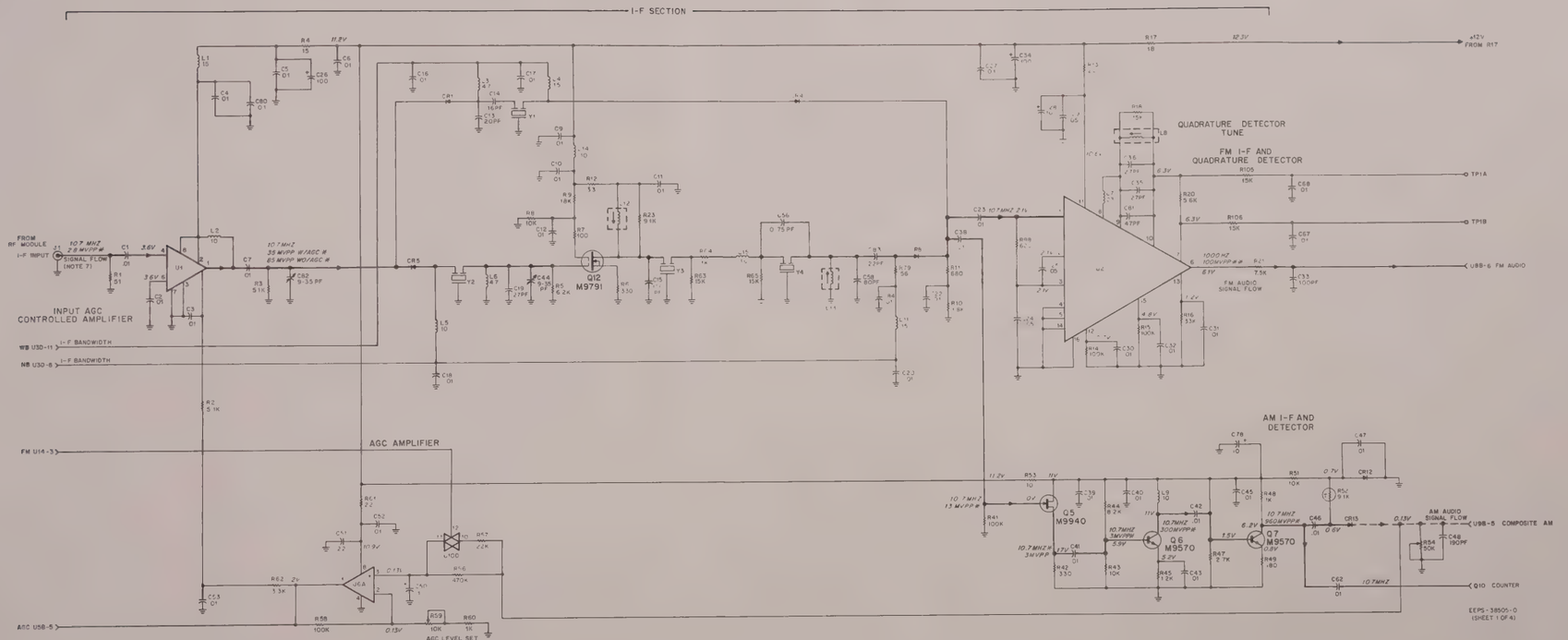
MODEL RTL4134B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

Motorola No. PEPS-38699-A
(Sheet 1 of 5)
4-1-84 PHI

RECEIVER BOARD

RECEIVER BOARD

MODEL RTL4134B
SCHEMATIC DIAGRAM, CIRCUIT
BOARD DETAIL, AND PARTS LIST



NOTES:

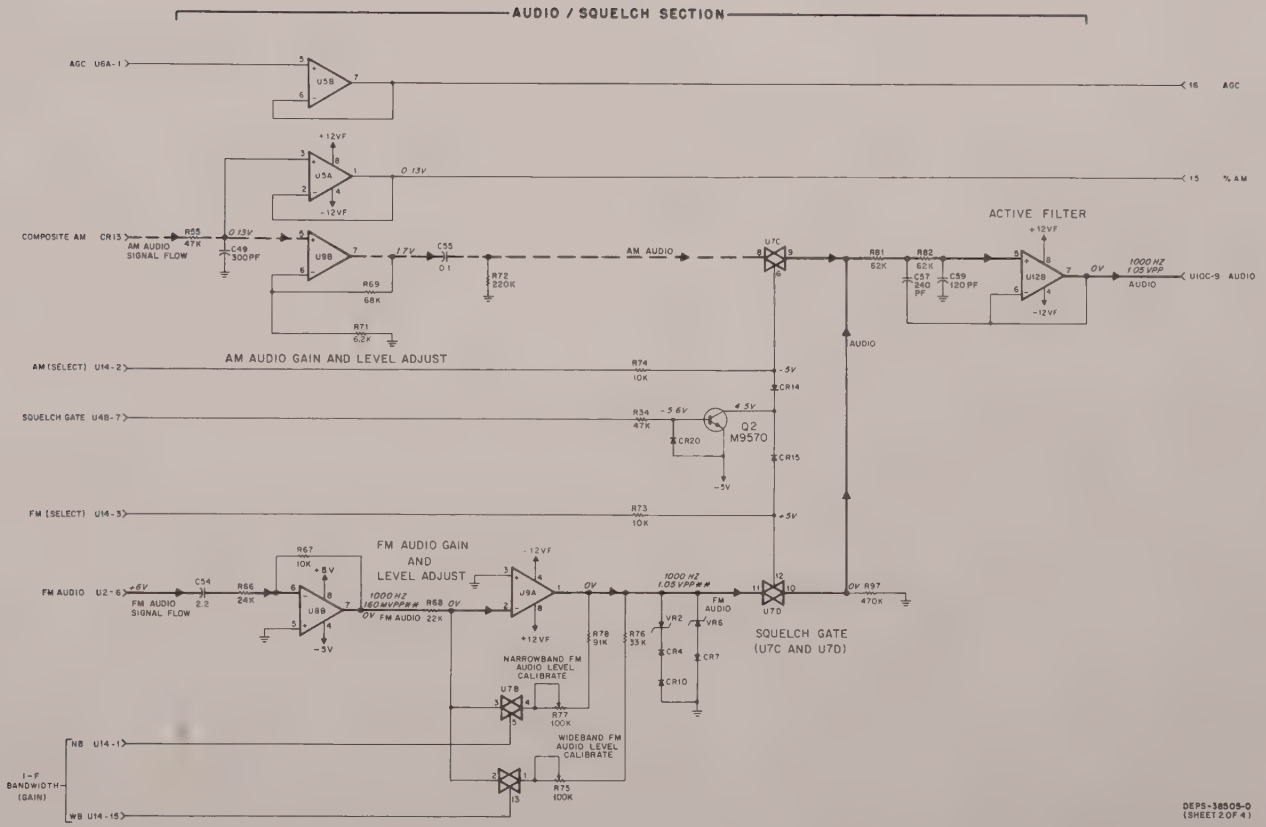
1. Unless otherwise indicated: resistor values are in ohms, capacitor values are in microfarads, and inductor values are in microhenries.
2. **DC voltages are measured with no i-f input, FM operating mode, narrow band i-f, and normal audio squelch open.
3. *10.7 MHz PP voltages are measured at —47.0 dBm input, narrow band FM.
4. **Audio voltages are measured at —47.0 dBm input, narrow band FM, normal audio, 5.00 kHz deviation, 1000 Hz modulating signal.
5. Integrated circuits on this board are TTL and CMOS devices.
6. IC types and connections for this board are as follows:

Reference Designation	Mfgr's Description	+5 V	−5 V	+12 V	−12 V	Unused	Gnd
U1	I-F Amp	—	—	2,8	—	—	4,5
U2	Quad Detector	—	—	11	—	—	4,7
U3	Quad Bi-Lat SW	—	7	14	—	—	
U4	Dual Op Amp	—	—	8	4	—	
U5	Dual Op Amp	—	—	8	4	—	
U6	Dual Op Amp	—	—	8	—	—	4
U7	Quad Bi-Lat SW	14	7	—	—	—	
U8	Dual Op Amp	8	4	—	—	1, 2, 3	
U9	Dual Op Amp	—	—	8	4	—	
U10	Quad Bi-Lat SW	14	7	—	—	—	
U12	Dual Op Amp	—	—	8	4	—	
U14	Quad Clk D Latch	16	6,8	—	—	11, 12	
U15	Quad Comparator	3	12	—	—	—	
U16	Quad Comparator	3	12	—	—	8, 9, 10 11, 13, 14	
U17	Dual 1-4 Decoder/Demux	16	—	—	—	4, 5, 7, 10, 11, 12	

7. 10.7 MHz signal flow shown for narrow band i-f.
8. Logic states shown are for FM, narrow band i-f, normal audio.

RECEIVER BOARD

MODEL RTL4134B
SCHEMATIC DIAGRAM, CIRCUIT
BOARD DETAIL, AND PARTS LIST

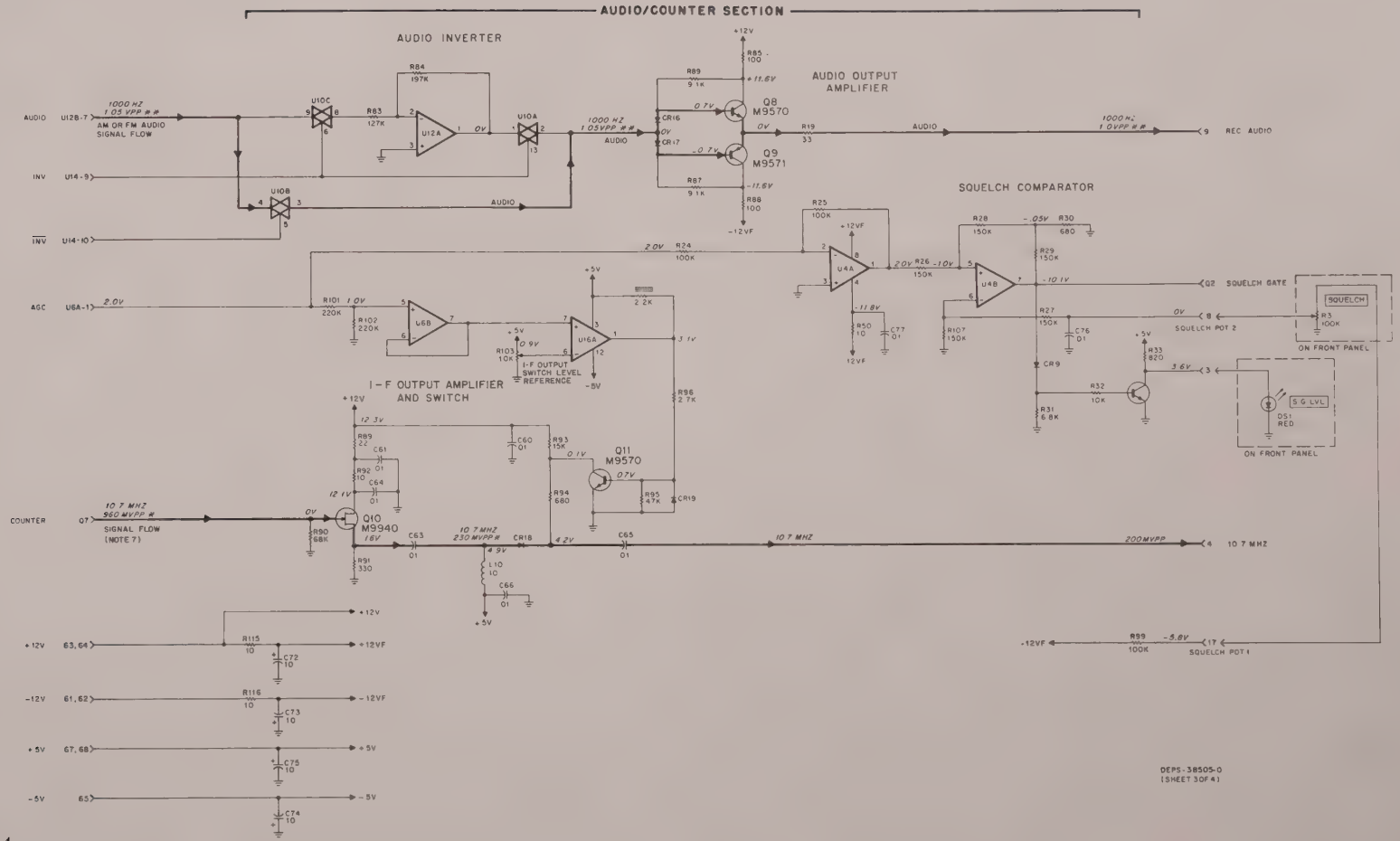


RECEIVER BOARD

Motorola No. PEPS-38699-A
(Sheet 3 of 5)
4/1/84- PHI

RECEIVER BOARD

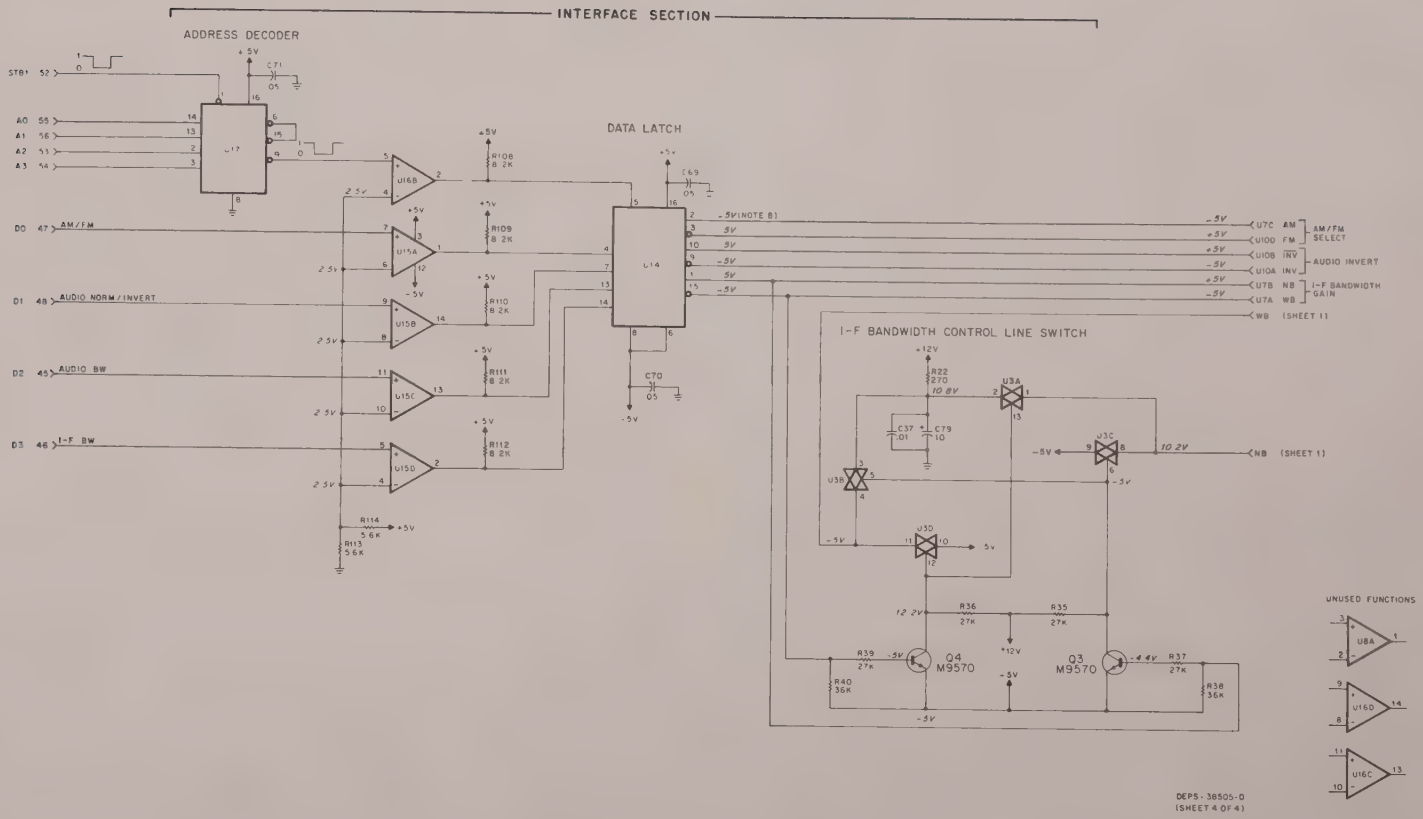
MODEL RTL4134B
SCHEMATIC DIAGRAM, CIRCUIT
BOARD DETAIL, AND PARTS LIST



Motorola No. PEPS-38699-A
(Sheet 4 of 5)
4/1/84- PHI

RECEIVER BOARD

MODEL RTL4134B
SCHEMATIC DIAGRAM, CIRCUIT
BOARD DETAIL, AND PARTS LIST



Motorola No. ***PEPS-38699-A***
(Sheet 5 of 5)
4/1/84- PHI

RECEIVER BOARD

ANALOG INTERFACE BOARD

MODEL RTL4092B

1. DESCRIPTION

1.1 The analog interface board (AIB) processes analog voltages to obtain an absolute value and sign voltage for the counter board. The AIB is a microprocessor controlled signal buffer, filter, and ranging device. The external vertical input voltages are multiplexed to obtain the absolute value and sign of the voltage that is sent to the counter.

1.2 The AIB consists of the four range attenuator, rms-dc converter, 1 kHz notch filter, ×.1 attenuator, absolute value amplifier, peak detector, and attenuator driver stage. All ac, dc, AGC, and other input and output signal connections are made through the main interconnect board.

2. THEORY OF OPERATION

2.1 RANGE ATTENUATOR

External DVM inputs to the VERT/SINAD/DIST/DVM IN input jack are ranged by the microprocessor over a four-decade range before being routed to the rms-dc converter. A relay ladder driven by inputs from the attenuator driver stage selects the ranging values prior to being sent to the ac/dc coupler. An ac filter consisting of C77, C78, R124, and R125 allows an accurate dc voltage measurement to be taken when an ac voltage is also present at the input by attenuating the ac signal.

2.2 RMS-DC CONVERTER

AC voltages are applied to multiplexer U4 which selects signals either before the notch filter or after the filter for both ac voltage and SINAD measurements. Battery voltage and AGC levels are also applied to U4. When measuring SINAD, the microprocessor switches the notched and unnotched signals input to U4 at 60 millisecond intervals.

2.3 TWO-STAGE 1 kHZ NOTCH FILTER

The two-stage notch filter consists of five distinct filters with two of the notch filters cascaded to obtain increased attenuation. The output of amplifier U2 is coupled across a high-pass filter made up of C79 and R80. Two low-pass filters attenuate frequencies above 19 kHz. The notch filter is designed to attenuate a 1 kHz signal by 50 dB.

2.4 ×.1 ATTENUATOR

The composite voltage output from multiplexer U6 is scaled by the ×.1 attenuator prior to being amplified by U7. Transistors Q2 and Q5 are level shifters. The ×.1 attenuator consists of Q1 and the combined impedance of R51, R38, and R36. The attenuated signal is amplified by voltage follower U7.

2.5 ABSOLUTE VALUE AMPLIFIER

The output of amplifier U7 is inverted by amplifier U8 while U9 determines the input polarity. The output of U8 and U7 is gated by U10 to the analog-to-digital converter on the counter board. Transistors Q7 and Q8 are level shifters and Q9 drives the sign polarity output.

2.6 PEAK DETECTOR CIRCUIT

The peak detector circuit provides dc outputs equal to the negative and positive peak values of the input signal relative to the average dc level of the input signal. The positive and negative signals are selected through the 1-of-8 multiplexer U6.

2.7 ATTENUATOR DRIVER STAGE

The attenuator driver stage provides the voltage to the range attenuator relays. Function data from the microprocessor is applied through buffer U15 to latches U16 and U17. The output of U16 controls the multiplexer, while U17 primarily controls the attenuator relays.

parts list

RTI 4092B Analog Interface Board — PL-6490-9

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: ±F > 80-20%; 25 V: unless otherwise stated
C1	8-84637L06	.0068 ± 5%, 630 V
C2	20-37307A11	5.5-18 pF variable
C3	21-84494B46	180 pF ± 3%; 500 V
C4	21-82428B47	.002; 500 V
C5	8-84637L47	.022 ± 5%, 250 V
C6	21-80397A11	.022 ± 5%; 50 V; NPO
C7	21-82428B21	.01 + 100-30%; 100 V
C8	21-88248B51	.00047; 500 V
C9, 10	21-80397A11	.022 ± 5%; 50 V; NPO
C11		NOT USED
C12	23-84538G24	2.56 - 10%; 35 V
C13	21-80397A11	.022 ± 5%; 50 V; NPO
C14, 15	23-84762H14	0.47 + 20%- 50 V
C16	21-84008H03	0.15; 50 V
C17		NOT USED
C18	21-84008H03	0.15; 50 V
C19	21-84494B46	180 pF ± 3%, 500 V
C20	21-82428B21	.01 + 100-30%; 100 V
C21	21-82372C07	.05; 25 V
C22	21-84494B42	27 pF ± 5%; 500 V
C23	21-82372C07	.05; 25 V
C24	23-84908L01	2.2 ± 20%; 50 V non polar
C25	21-84008H05	0.15; 50 V
C26	21-84494B42	27 pF ± 5%; 500 V
C27	21-84008H03	0.15; 50 V
C28	21-84494B46	180 pF ± 3%; 500 V
C29	21-84008H27	0.1; 50 V
C30, 31	21-82428B21	0.1 + 100-30%; 100 V
C32	23-84665F01	10 + 100-10%; 25 V
C33	21-80797A01	0.47 + 10%; 50 V
C34	21-82372C07	.05; 25 V
C35	21-84008H03	0.15; 50 V
C36, 37	21-82428B21	0.1 + 100-30%; 100 V
C38, 39	21-82372C07	.05; 25 V
C40, 41	21-84008H27	0.1; 50 V
C41	23-84665F01	10 + 100-10%; 25 V
C42	21-80397A01	0.47 + 10%; 50 V
C43	21-82428B21	0.1 + 100-30%; 100 V
C44	21-84008H06	033 10%; 50 V
C45	21-82372C07	.05; 25 V
C46 thru 49	21-84008H03	0.15; 50 V
C50, 51	21-82428B21	0.1 + 100-30%; 100 V
C52, 53	21-82372C07	.05; 25 V
C54	21-82428B21	0.1 + 100-30%; 100 V
C55	21-84065P03	16 pF ± 5%; 500 V; NPO
C56 thru 59	21-82372C07	.05; 25 V
C60 thru 63	23-84665F01	10 + 100-10%; 25 V
C64	21-82428B21	0.1 + 100-10%; 25 V
C65	21-82372C07	.05; 25 V
C66		NOT USED
C67 thru 69	21-82428B21	0.1 + 10-30%; 100 V
C70		NOT USED
C71	21-80370A04	022 + 10%- 100 V
C72		NOT USED
C73	23-84708L01	2.2 ± 20%; 50 V non polar
C74	21-84665F01	10 + 100-10%; 25 V
C75	21-84008H03	0.15; 50 V
C76	21-84494B13	10 pF ± 5%; 500 V
C77	23-84908L01	2.2 ± 20%; 50 V non polar
C78	21-84008H23	0.22 + 10%; 100 V
C79, 80, 81	21-84008H27	0.1; 50 V
C82		NOT USED
C83	8-84637L24	.068 ± 10%; 100 V
C84	23-84538G02	4.7 - 20%+ 50 V
C85	23-84908L21	2.2 ± 20%; 50 V non polar
C86	23-84762H14	0.47 ± 20%; 50 V
C87	23-84535G28	0.33 ± 10%; 35 V
		diode: (see note)
CR1 thru 6	48-83654H01	silicon
CR8	48-83654H01	silicon
CR12 thru 15	48-83654H01	silicon
CR16	48-84618A09	hot carrier
		relay, reed:
K1 thru 6	80-80346A01	12 V
		resistor, fixed: ±5%; 1/4 W: unless otherwise stated
R1	6-80390A85	1.82 meg ± 0.25%
R2	6-80390A86	182k ± 0.25%
R3	6-80390A87	18.2k ± 0.25%
R4	6-80390A88	2.1k ± 0.25%
R5	6-80390A89	54.9k ± 0.25%
R6		NOT USED
R7	6-10621E85	1.0 meg ± 1%; 1/8 W
R8	18-83452F11	var. 5k
R9	6-124A73	10k
R10, 11		NOT USED
R12	18-83452F11	var. 5k
R22, 23	6-10621C60	4.75k ± 1%; 1/8 W
R24	18-83452F09	var. 1k
R25, 26, 27		NOT USED

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
R28	6-10621B98	1.1k ± 1%; 1/8 W
R29	6-10621E85	1.0 meg ± 1%; 1/8 W
R30	18-83452F23	var., 500k
R31, 32, 33		NOT USED
R34	8-84640C97	6.98k ± 0.5%; 1/8 W
R35	8-84640C27	2.87k ± 0.5%; 1/8 W
R36	8-84640C81	499k ± 0.5%; 1/8 W
R37	6-80390A84	54.9 ± 0.5%
R38	8-84640C20	511 ± 0.5%; 1/8 W
R39	6-124A97	100k
R40	8-84640C70	73.2k ± 0.5%; 1/8 W
R41	6-124A94	75k
R42	6-124A61	3.3k
R43	8-84640C70	73.2 - 0.5% - 1/8 W
R44	8-84640C87	35.7k ± 0.5%; 1/8 W
R45	6-83175C72	75k ± 1%, 1/8 W
R46	6-10621E85	1.0 meg ± 1%; 1/8 W
R47	6-124A10	24
R48	6-124B50	15 meg
R49	6-124A53	1.5k
R50	6-124A72	9.1k
R51, 52	6-124A97	100k
R53	6-124A73	10k
R54	6-124B22	1.0 meg
R55	18-83452F13	var. 10k
R56	6-124A80	20k
R57	6-124B22	1.0 meg
R58	6-124B40	5.6 meg
R59, 60	8-84640C70	73.2k ± 0.5%; 1/8 W
R61	6-124B22	1.0 meg
R62	18-83452F13	var. 10k
R63	6-124A80	20k
R64	6-124B22	1.0 meg
R65	6-124B40	5.6 meg
R66	6-124A49	1k
R67	6-124A73	10k
R68 thru 74	6-124A61	3.3k
R75	6-10621C27	2150 + 1% 1/4 W
R76 thru 79	6-124A73	10k
R80	6-124A67	5.6k
R81	6-124A73	10k
R82		NOT USED
R83	6-124A73	10k
R84	6-124A61	3.3k
R85		NOT USED
R86	6-124A66	5.1k
R87	6-124A56	2.4k
R88	6-124A97	100k
R89	6-124A61	3.3k
R90	6-10621D42	33.3k ± 1%; 1/8 W
R91	6-83175C72	75k ± 1%; 1/8 W
R92, 93		NOT USED
R94	6-10621D07	14.3k ± 1%; 1/8 W
R95	8-84640C97	6.98k ± 0.5; 1/8 W
R96	8-84640C27	2.87k ± 0.5%; 1/8 W
R97 thru 100	9-80390A91	15dk ± 0.25% 1/8 W
R101	18-83452F09	var. 1k
R102	6-124A76	13k
R103	6-124A61	3.3k
R104	6-124A49	1k
R105, 106	6-10621C91	10k + 1%
R107	6-124A61	3.3k
R108	6-124A94	75k
R109		*NOT USED
R110	6-10621D88	100k + 1% 1/8 W
R111	6-124C25	100 + 10%
R112		NOT USED
R113	8-84640C97	6.98k ± 0.5%, 1/8 W
R114, 115	8-80390A90	6.98k ± 0.25% 1/8 W
R116	8-84640C97	6.98k ± 0.5%; 1/8 W
R117, 118	8-80390A90	6.98k ± 0.25% 1/8 W
R119	18-83452F09	var. 1k
R120, 121	8-84640C97	6.98k ± 0.5% 1/8 W
R122, 123	6-124A20	62
R124	6-124A91	56k
R125	6-124A67	5.6k
R126	6-124A55	1.8k ± 5%
R127	6-124A64	4.3k
R128 thru 130	6-124A73	10k
R131	6-124A72	9.1k
R132, 133	6-124A59	2.7k ± 5%
R134, 135	6-124A97	100k
		transistor: (see note)
Q1	48-84308A43	FET, N-channel; type M0843
Q2, 3	48-869570	NPN; type M9570
Q4, 5	48-869571	PNP; type M9571
Q6 thru 9	48-869570	PNP; type M9570
Q10, 11	48-869571	PNP; type M9571
Q12, 13, 14	48-869570	NPN; type M9570
Q15, 16	48-869831	FET, N-channel; type M9831
Q17	48-869571	PNP; type M9571

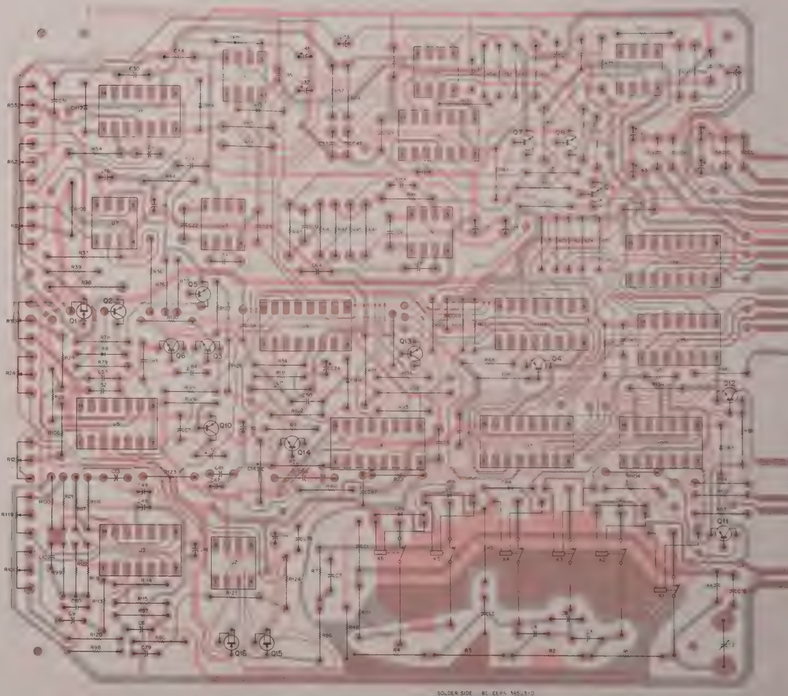
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U2	51-80365A09	operational amplifier
U3	51-84561L75	quad operational amplifier
U4	51-82884L54	4-channel analog multiplexer
U5	51-80365A13	rms adc converter
U6	51-82884L46	8-channel analog multiplexer
U7	51-80365A09	operational amplifier
U8, 9	51-80365A27	operational amplifier
U10	51-82884L46	quad analog switch
U11	51-80385A12	dual operational amplifier
U12	51-80365A26	dual comparator
U13, 14	51-80365A07	dual op amp
U15	51-84561L03	*hex inverter
U16, 17	51-82884L70	*hex D type flip flop
U18	51-84561L42	dual 1-4 decoder/demultip exer
U19		NOT USED
U20	51-83629M08	quad op amp
		sockets:
X1	9-84906E01	SOCKET, 14 pin
		mechanical part
M1, 2	45-80395A38	EJECTOR

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers

ANALOG INTERFACE BOARD

MODEL RTI 4092B

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



SHOWN FROM COMPONENT SIDE

SOLDER SIDE — BC-EEPS 5801-1-0
COMPONENT SIDE — BO-EEPS 5800-1-0
C-EEPS 5870-1-0

P4

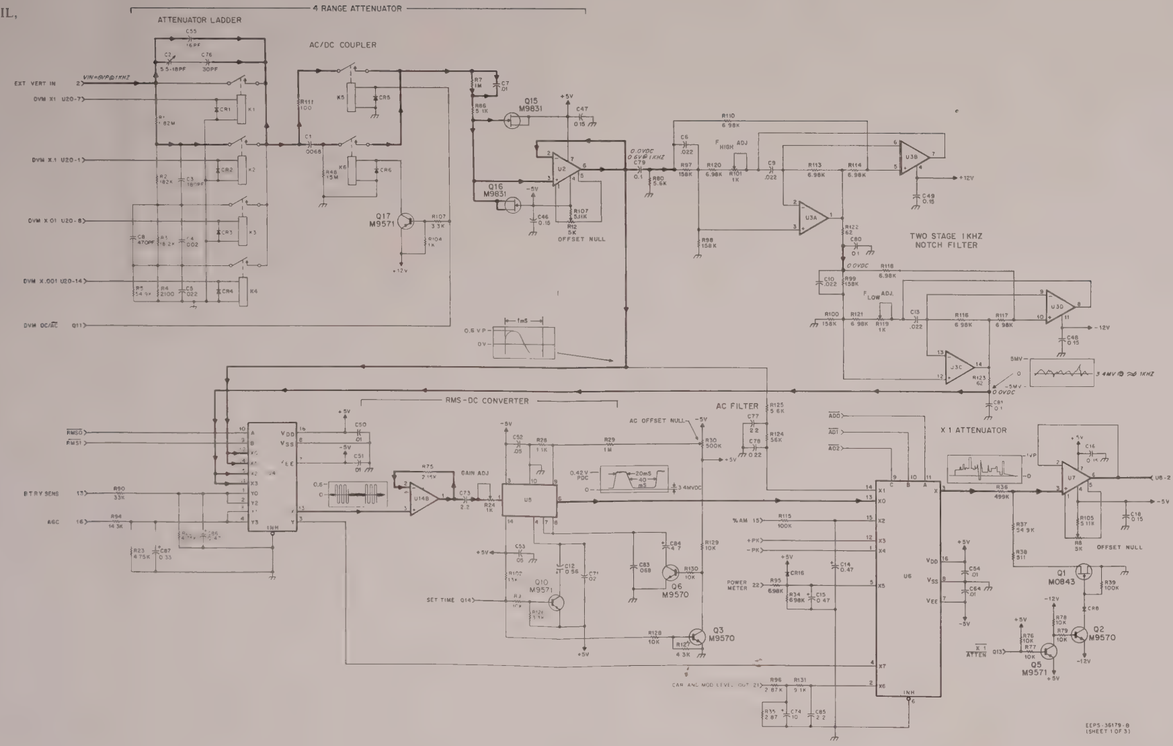
SYMBOL NO.	SIGNAL	SYMBOL NO.	SIGNAL
P1	GND	12	GND
63	+5V	62	+5V
61	+15V	60	-15V
59	+15V	58	-15V
57	SIGN	56	GND
55	A8	56	A1
53	A7	54	A3
49	STBY		
47	D8	48	D1
45	D7	46	D3
43	D6	44	D5
39	PSH		
21	GAIN MOD LEVEL OUT	22	PWR MTR
15	MUX	16	ADC
13	BTRY SENS	14	A/D
3	GND	4	GND
1	GND	2	EXT VERT IN

ANALOG INTERFACE BOARD

Motorola No. PEPS-36849-B
(Sheet 1 of 4)
4-1-84-PHI

ANALOG INTERFACE BOARD

MODEL RTL4092B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



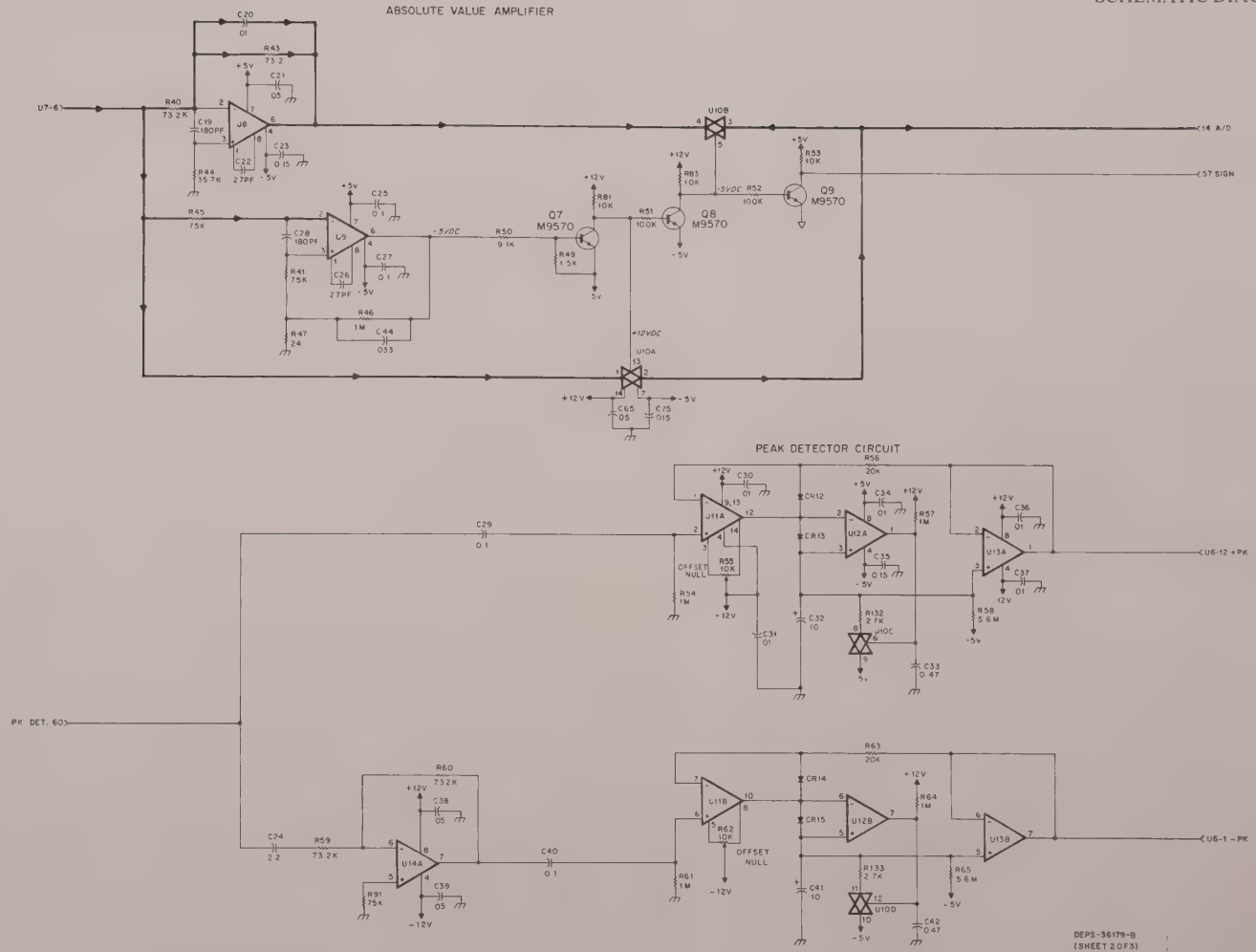
Notes.

1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads, and inductor values are in millihenries
2. Integrated circuits on this board are TTL and CMOS devices
3. IC types and connections for this board are as follows:

Reference Designation	Mfgr's Description	+5 V	−5 V	+12 V	−12 V	GND
U2, 7	Op Amp	7	4	—	—	
U3	Quad Diff Op Amp	—	—	4	11	
U4	4-Channel Analog Mux	16	7	—	—	8, 6
U5	AC/DC Converter	14	3	—	—	10
U6	8 CH Analog Mux	16	7	—	—	8, 6
U8	Op Amp	7	4	—	—	
U9	Op Amp	7	4	—	—	
U10	Quad Analog Switch	—	7, 9, 10	14	—	—
U11	Dual Op Amp	—	—	8, 13	4	
U12	Comparator	8	4	—	—	
U13, 14	Dual Op Amp	—	—	8	4	
U15	Hex Inverter	14	—	—	—	7
U16, 17	Hex D Flip/Flp	16	—	—	—	8
U18	Dual 1-4 Decoder/Demux	16	—	—	—	8
U00	Quad Op Amp	—	—	4	—	11

ANALOG INTERFACE BOARD

MODEL RTL4092B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

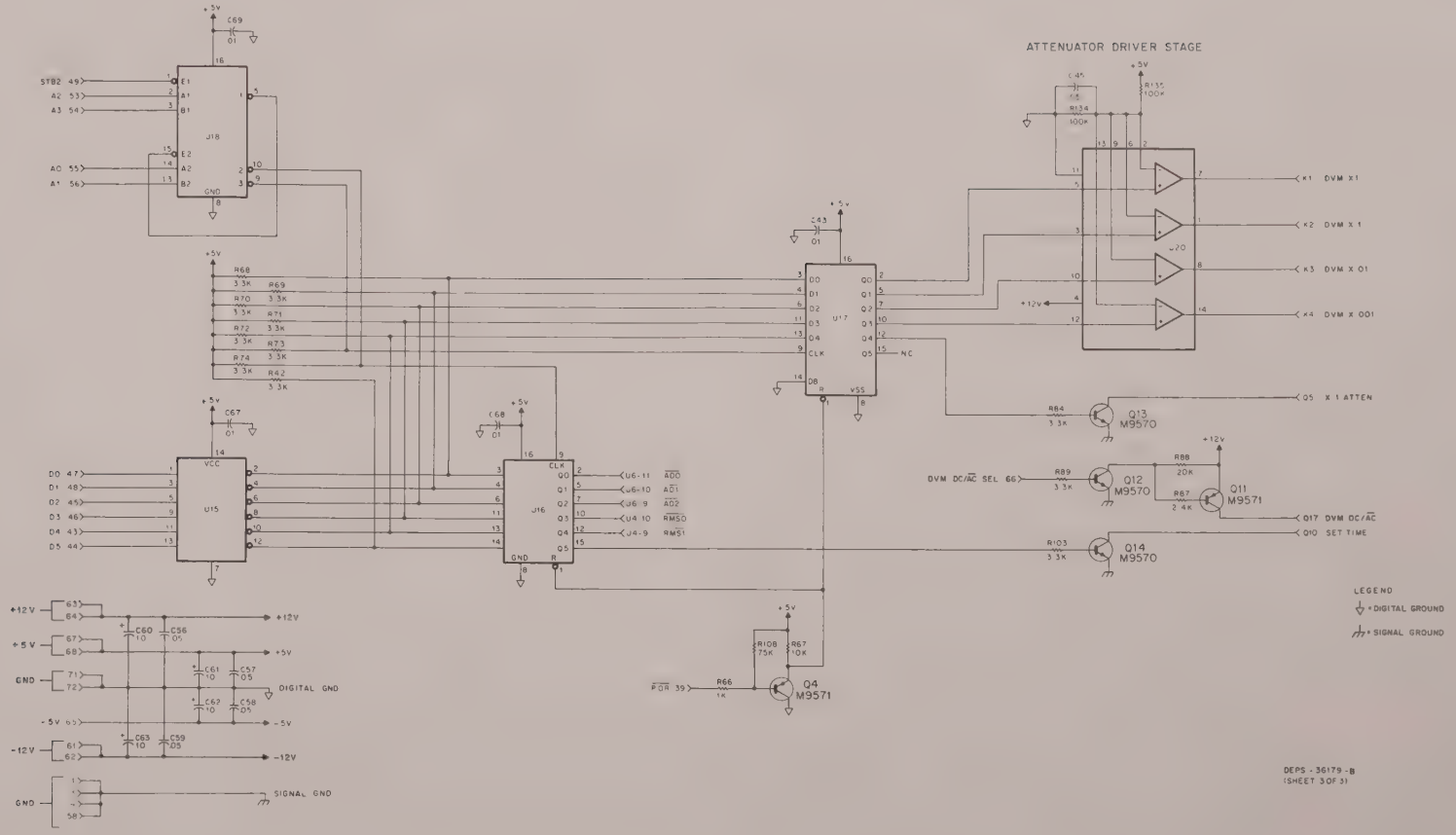


*Motorola No. **PEPS-36849-B***
(Sheet 3 of 4)
4/1/84- PHI

ANALOG INTERFACE BOARD

ANALOG INTERFACE BOARD

MODEL RTL4092B
SCHEMAIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



Motorola No. PEPS-36849-B
(Sheet 4 of 4)
4/1/84- PHI

CENTRAL PROCESSING UNIT (CPU) BOARD

MODEL RTC4023A

1. DESCRIPTION

The central processing unit (CPU) board contains the microprocessor, program memory, read/write memory, and input/output buffers. The card uses a Motorola M6800 series microprocessor, a 16k × 8 ROM, and a 384 × 8 RAM.

2. THEORY OF OPERATION

2.1 INPUT/OUTPUT BUS

The CPU communicates with all the modules in the service monitor through the I/O bus. The bus consists of eight bidirectional data lines, four address lines, and four strobe lines. A second bus consisting of eight bidirectional data lines, two handshake lines, and two status lines is available for the optional tone signaling card. In addition to the two buses, there are six dedicated I/O lines: DPL, LC. BUSY, AD. INT., COUNT INT., $\overline{\text{SQ OPN}}$, and $\overline{\text{IRQ}}$.

2.2 MICROPROCESSOR

2.2.1 An M6805 microprocessor is used to control the service monitor operating modes. The device contains 16 I/O lines in two ports, 112 bytes of internal RAM, and a total addressable complement of 8192 bytes. An external RAM of 384 bytes is provided, along with two 8k × 8 programmed memories. The low order lines are BØ-B7 and the high order address and data lines are A8-A12. The low order lines are multiplexed whereas the high order lines are not. The AS and DS signals are derived from the 3.40 MHz crystal oscillator. The 680 kHz DS signal is further divided to obtain a 340 kHz signal used by the front panel interface module.

2.2.2 Memory Access

The lower address bits are latched by U5 during the high-to-low transition of AS. The selected address is routed to ROM, RAM, and the I/O decoding logic. High order address bits are routed directly to ROM and the chip select decoding logic. Addresses below $0200 are selected by PB7 (MEM SEL); and PB5 (ROM SEL) is used to select the main ROM (U4), or the auxiliary ROM (U22). Shift register U21 delays ROM SEL for four address strobe cycles to simplify ROM paging for the operating program. Data selector U9 is used to divide locations before $0200 into four 128-byte segments. U9 applies ROM, RAM, and I/O select signals. Chip selects for U4 and U22 are decoded by U7 and U8.

2.2.3 Input/Output

2.2.3.1 The two communication buses are interfaced to the CPU through several input and output ports. All input devices drive the address/data lines directly. Output ports receive data from the microprocessor PAØ-PA7 lines. Lines PBØ-PB4 and PB6 are buffered directly from the microprocessor. When PB7 is high and the selected address is between $0080 and $00FF, U9 generates an I/O select ($\overline{\text{IOSEL}}$). An $\overline{\text{IOSEL}}$ and $\overline{\text{A3}}$ enables U12 to select one of seven ports.

2.2.3.2 The selects enable U13, U15, and U17 to drive the multiplexed bus. The ports are read by the microprocessor with normal memory access. To alter the contents of an output latch, the microprocessor first places new data on the PA lines, and then, by referencing the memory address of the latch, clocks the information into the latch. PB4 and I/O bus drive disable signals for U16 to a high impedance during I/O bus read. U18 is in the high impedance state when the microprocessor reads the option bus.

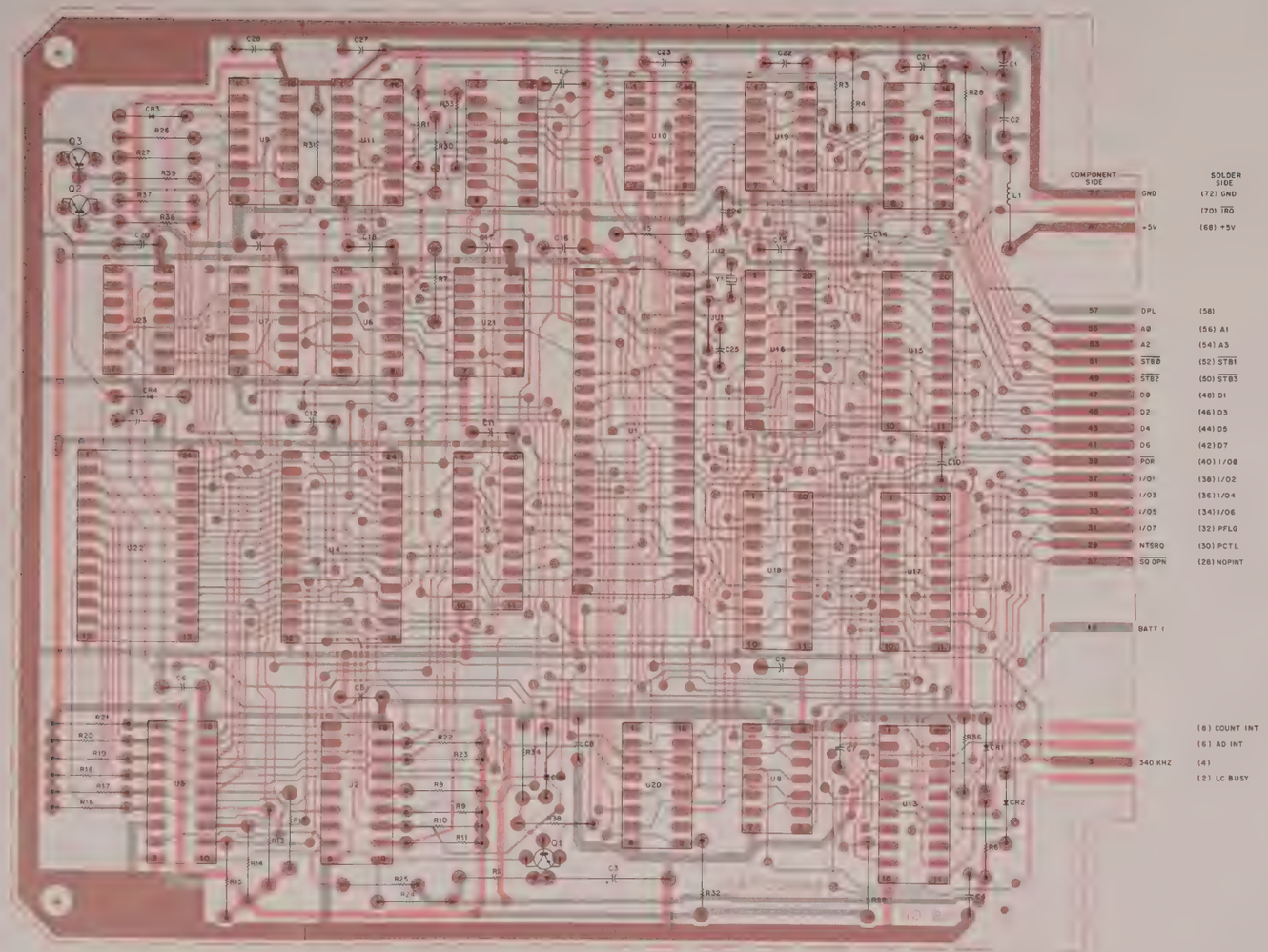
2.2.4 CMOS RAM

Data held in RAM's U2 and U3 is preserved by voltage from the lithium battery on the front panel interface board. Diodes CR1 and CR2 switch RAM power between the +5 V supply and the battery. The $\overline{\text{P.O.R.}}$ (power-on-reset) generated by the front panel interface senses the loss of power and resets the microprocessor and U5. Line A8 is held low through U11 and CR3. Q1 and Q2 disconnect R/$\overline{\text{W}}$ and chip select from the RAM's to inhibit access during power transitions.

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

CPU BOARD

MODEL RTC4023A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



SOLDER SIDE - BD-EEPS-36368-0
COMPONENT SIDE - BD-EEPS-36369-0
OVERLAY OL-EEPS-36367-A

SHOWN FROM COMPONENT SIDE

parts list

RTC4023A CPU Board PL-8454-0

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed uF; +70-30%; 100 V: unless otherwise stated
C1	23-84665F01	10 uF + 100-10%; 25 V
C2	21-82428B21	.01
C3	23-84762H10	22 uF ± 20%; 15 V
C4 thru 24	21-82428B21	.01
C25, 26	21-82355B11	30 pF ± 5%; 500 V
C27, 28	21-82428B21	.01
		diode: (see note)
CR1, 2	48-84616A01	hot carrier
CR3	48-83654H01	silicon
CR4, 5	48-84616A01	hot carrier
		coil, rf:
L1	24-83451F01	choke; 15 uH
		transistor: (see note)
Q1, 2	48-869570	NPN; type M9570
Q3	48-869571	PNP; type M9571
		resistor, fixed; ± 5%; 1/4 W: unless otherwise stated
R1	6-11009C73	10k
R2	6-11009C25	100
R3, 4	6-11009C73	10k
R5	6-124B30	2.2 meg
R6	6-11009C01	10
R7 thru 24	6-11009C73	10k
R25, 26, 27	6-11009C49	1k
R28 thru 33	6-11009C73	10k
R34	6-11009C61	3.3k
R35	6-11009C49	1k
R36	6-11009C73	10k
R37	6-11009C61	3.3k
R38	6-11009C49	1k
R39	6-11009C73	10k
		integrated circuit: (see note)
U1	51-83625M44	microprocessor
U2, 3	51-83625M55	512 × 4 RAM
U4	51-80397A23	8k × 8 ROM
U5	51-82609M17	octal D flip-flop
U6	51-84561L03	hex inverter
U7	51-84561L38	triple NOR gate
U8	51-83627M04	quad open collector NAND gate
U9	51-84561L47	dual 2 to 4 decoder
U10	51-82884L13	dual D flip-flop
U11	51-82884L02	hex inverter
U12	51-84561L41	1 of 8 decoder
U13	51-82609M56	octal buffer
U14	51-84561L51	hex D flip-flop
U15	51-82609M56	octal buffer
U16	51-82627M03	octal D latch
U17	51-82609M56	octal buffer
U18	51-83627M03	octal D latch
U19	51-84561L03	hex inverter
U20	51-82884L70	hex D flip-flop
U21	51-82609M52	8-bit serial input/parallel output shift register
U22	51-80397A24	8k × 8 ROM
U23	51-84561L08	triple NAND gate
		crystal: (see note)
Y1	48-80378A44	3.4 MHz
		mechanical parts
	45-80395A37	EJECTOR, (YEL); 2 used
	9-84881F01	SOCKET, 24 contact; 2 used
	9-83893M01	SOCKET, 40 contact
	42-10217A24	TIE, wrap
	14-84602K01	INSULATOR, crystal
	84-80377A83	PC BOARD

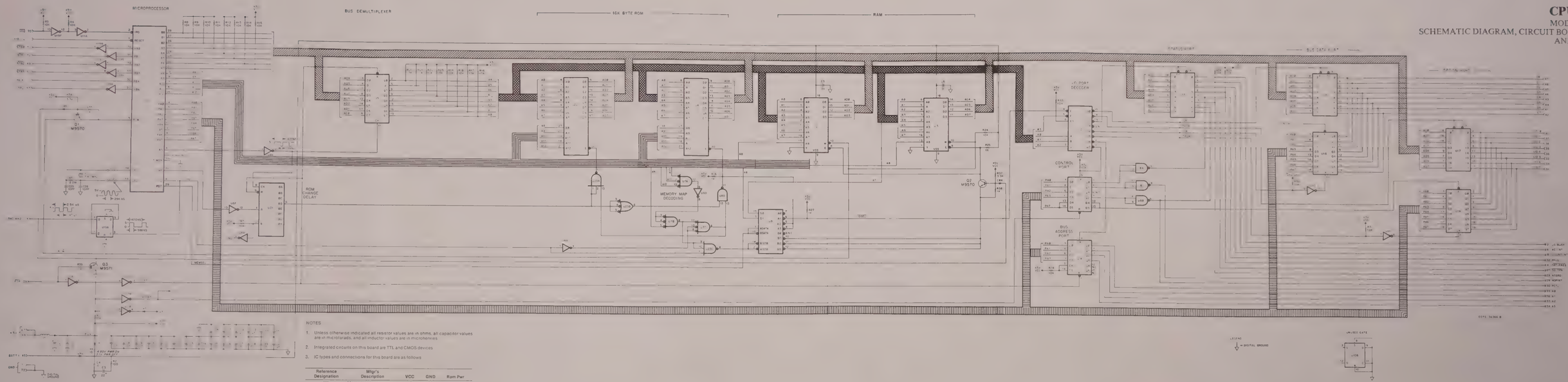
note: For optimum performance, diodes, transistors, crystals, and integrated circuits must be ordered by Motorola part numbers.

*Motorola No. **PEPS-36850-A***
(Sheet 1 of 2)
4/1/84- PHI

CPU BOARD

MODEL RTC4023A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



NOTES

1. Unless otherwise indicated all resistor values are in ohms, all capacitor values are in microfarads, and all inductor values are in microhenrys.
2. Integrated circuits on this board are TTL and CMOS devices.
3. IC types and connections for this board are as follows:

Reference Designation	Mfgr's Description	VCC	GND	Ram Pwr
U1	Microprocessor	40	20	
U2	512 x 4 RAM		9	18
U3	512 x 4 RAM		9	18
U4	8k x 8 ROM	24	12	
U5	Octal D Flip-Flop	20	10	
U6	Hex Inverter	14	7	
U7	Triple NOR	14	7	
U8	Quad Open Coll NAND	14	7	
U9	Dual 2 to 4 Decoder	16	8	
U10	Dual D Flip-Flop	14	7	
U11	Hex Inverter	1	8	
U12	1 of 8 Decoder	16	8	
U13	Octal Buffer	20	10	
U14	Hex D Flip Flop	16	8	
U15	Octal Buffer	20	10	
U16	Octal D Latch	20	10	
U17	Octal Buffer	20	10	
U18	Octal D Latch	20	10	
U19	Hex Inverter	14	7	
U20	Hex D Flip-Flop	16	8	
U21	8 Bit Serial/Parallel Shift	14	7	
U22	8k x 8 ROM	24	12	
U23	Triple NAND	14	7	

Motorola No. PEPS-36850-A
(Sheet 2 of 2)
4-1-84 PH

COUNTER BOARD
MODEL RTL4106A

1. DESCRIPTION

The counter board consists of the microprocessor bus interface frequency error and PL (Private-Line™) counter, analog-to-digital converter, and audio circuitry.

2. THEORY OF OPERATION

2.1 MICROPROCESSOR INTERFACE

The counter communicates with the microprocessor via the system data and address bus. The address and strobe are decoded by address decoder U1 to obtain load commands and control pulses. The data bus, DØ-D7, is connected to control latch U14 and output drivers U10 and U11. The drivers gate data onto the data bus when enabled by the A/D and counter read commands. U14 latches the bits that control the audio routing. The AC/DC SEL command output of U14 is sent to the analog interface board (AIB) where it controls the coupling of the external input to the AIB. U24 is the counter mode latch that generates the FREQ ERROR/PL and .1/.01 SEC GATE signals that are used to control the mode of operation.

2.2 COUNTER OPERATION, FREQUENCY ERROR MODE

2.2.1 Counter mode latch U24 enables the counter to measure the receiver i-f frequency. The microprocessor reads the i-f, subtracts 10.7 MHz, and displays the result on the front panel LCD. The 10.7 MHz signal from the receiver is applied to the phase comparator input of phase-locked loop U26. The i-f is compared with that of the PLL VCO to produce an error voltage that locks the VCO frequency to that of the input i-f. Thus, the VCO output of U26 is a low noise reproduction of the i-f, and is further amplified by transistors Q5 and Q6. With U24-2 high, the B inputs to multiplexer U2 are gated to the U2 outputs. U23A divides the SYNTH 1 kHz frequency by 10. U25A and U25B select either 1 kHz or 100 Hz for the clock input of U3 providing a .01 second or 0.1 second gate time for the frequency counter. The count input to counter U8 is connected to the squared VCO signal and the enable command is sent to U6-4 via U2.

2.2.2 Counter operation begins when the counter start pulse (START COUNT) is decoded at U1. The pulse causes U5 to toggle causing preset to be removed from U3, and U8 counts the i-f frequency. $\overline{\text{COUNT ENABLE}}$ stays low until U3 rolls over from the F state to Ø. Thus, U8 is enabled for 10 cycles of the gate clock. State F is decoded internally by U3 and appears at the carry output, U3-7. The low-to-high transition of the carry toggles U5 Q output high. U3 returns to preset and the count cycle ends. The low-to-high transition of $\overline{\text{COUNT ENABLE}}$ latches an interrupt into U13B to end the microprocessor cycle. The counter interrupt latch is cleared by the $\overline{\text{CTR READ}}$ pulse. The microprocessor reads three bytes from U8 sequentially and then resets U8 by addressing U1-9.

2.3 COUNTER OPERATION, PL MODE

2.3.1 Before the sub-audible PL tone can be counted, it must be separated from the recovered audio. The PL filter comprised of U20A, U21, and U22 has a cutoff frequency of 270 Hz and this signal is squared for counting by U20B and Q4.

2.3.2 With U24-2 low, the counter is in the PL mode and the A inputs of U2 are gated to the U2 output. The count input of U8 is connected to the 10 MHz timebase and the PL tone drives the clock input of U3. The count enable of U8 is driven from the carry output of U3. PL frequency is measured by gating 10 MHz into U8 for one period of the audio tone. The microprocessor reads the number of 10 MHz pulses counted, multiplies by 100 nanoseconds per pulse and calculates the reciprocal of the time to obtain the PL frequency.

2.3.3 Counter operation is similar to that for frequency error except that U3 is preset to a different value and U23B is enabled. For normal operation in which a tone is present, reset is removed from U23B; preset is removed from U3 when U5 toggles after a counter start pulse is decoded. The carry output of U3

goes low at the first low-to-high transition of the PL tone. $\overline{\text{COUNT ENABLE}}$ is low and U8 counts the 10 MHz input. On the next low-to-high transition of the tone, $\overline{\text{COUNT ENABLE}}$ goes high, the counter interrupt is latched, and U5 toggles causing U23B to reset and U3 to be preset.

2.3.4 If the subaudible tone frequency is below 16 Hz, U23-14 goes high before U3 completes its cycle. The abort pulse generated at U7-12 drives U3 to the preset state, clears U8, and forces a counter interrupt. U23B acts as a timer to ensure that the control logic does not get hung up when PL input is absent.

2.4 ANALOG-TO-DIGITAL CONVERTER

2.4.1 The analog-to-digital (A/D) converter, U9, changes the input voltage on the AD INPUT line into a 10-bit data word. The A/D converter accepts input voltages in the range of 0-999 mV full scale. A separate sign bit from the AIB is read by the microprocessor through U11 to indicate input polarity.

2.4.2 The +2.49 V dc supplied by Zener diode VR1 is inverted by U12. The reference current developed through R20, R21, and R22 sets the full scale voltage of the A/D converter. The zero voltage offset of U9 is cancelled by adjusting R17.

2.4.3 An A/D conversion is initiated when U1 decodes the $\overline{\text{AD START}}$ command. When the conversion is completed, U9-23 goes high and clocks the A/D interrupt latch U13B. The interrupt informs the microprocessor that data is available. After the processor reads the A/D data, U13B is reset.

2.5 PEAK DETECTOR SWITCHING

The 1-of-4 select, U15, selects one of four signals for application to the peak detectors on the AIB. The signals are the MOD; REC AUD; CAR & MOD LEVEL OUT; and PCT AM.

2.6 SPEAKER AUDIO SWITCHING

U17A switches MOD or REC AUD to the speaker volume control. U17C serves as a speaker audio mute switch. The return from the wiper of the volume control is summed by U16B with the keyboard response tone from U25C and the alarm tone from U25B. The generate modulation and recovered audio are buffered separately by U16A and U18A which drive the front panel MOD and DEMOD OUT jacks.

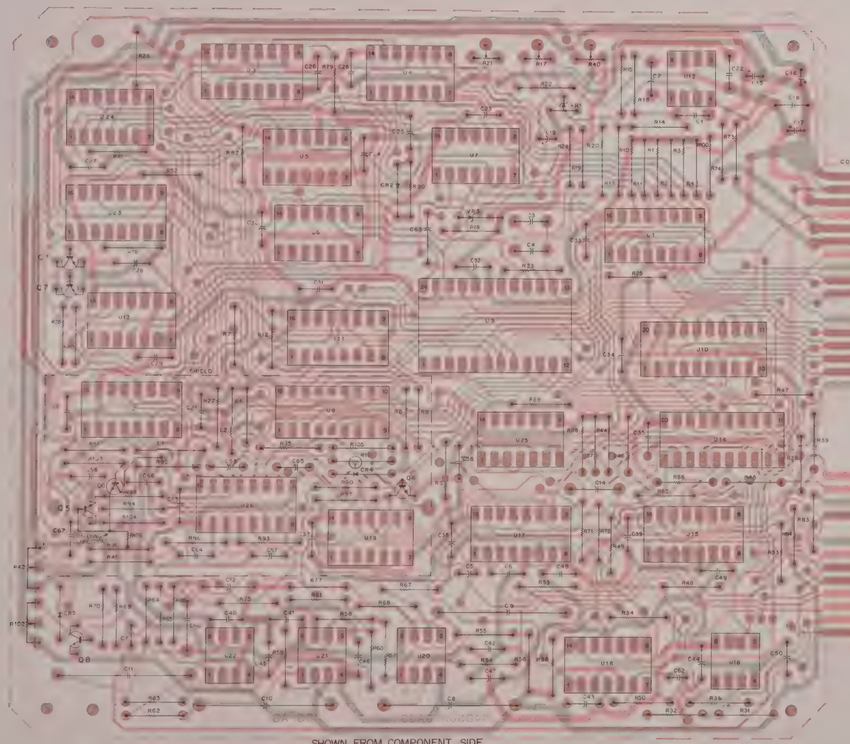
2.7 AM AUDIO SWITCHING

U17B gates modulation audio plus a dc bias signal onto the AM MOD line when the unit is in AM generate mode. The dc bias reduces the rf output level to provide sufficient modulation headroom for AM.

COUNTER BOARD

MODEL RTL4106A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



Motorola No. PEPS-36851-A
(Sheet 1 of 2)
4/1/84-PHI

parts list

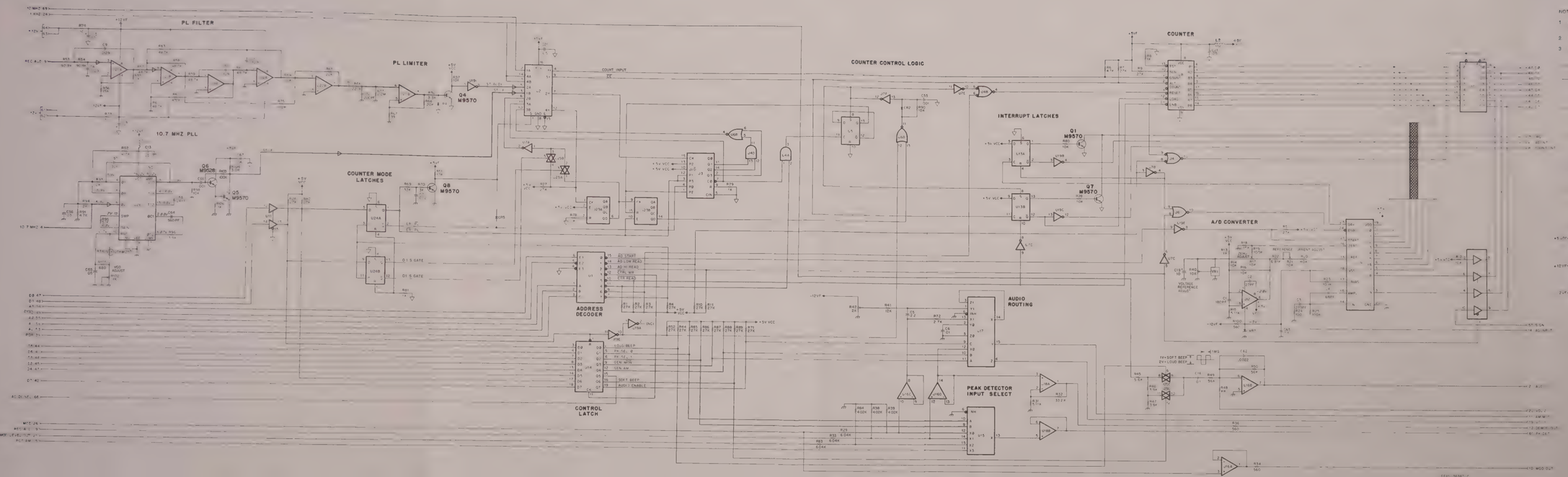
RTL4106A Counter Board PL-6465-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: pF ±5%; 500 V; unless otherwise stated
C1	21-84494B46	180 ± 3%
C2	21-84494B42	27
C3	21-82187B10	270
C4	21-84494B34	68
C5	21-84908L01	2.2 uF ± 20%; 50 V
C6	21-82428B21	.01 uF ± 10-30%; 100 V
C7	21-82187B27	.002 uF ± 10%; 100 V
C8, 9, 10, 11	8-84326A20	.0129 uF ± 2%; 50 V
C12	21-8474352	1000 pF ± 5%; 300 V
C13	21-82372C07	.05 uF ± 80-20%; 25 V
C14	21-82372C03	0.1 uF ± 80-20%; 25 V
C15, 16, 17	21-84665F01	10 uF + 100-10%; 25 V
C18	21-82428B21	.01 uF ± 10-30%; 100 V
C19	21-84665F01	10 uF + 100-10%; 25 V
C20, 21	21-82372C07	.05 uF ± 80-20%; 25 V
C22 thru 36	21-82428B21	.01 uF ± 10-30%; 100 V
C37	21-82372C07	.05 uF ± 80-20%; 25 V
C38 thru 50	21-82428B21	.01 uF ± 10-30%; 100 V
C51 thru 54		NOT USED
C55	21-82187B20	.001 uF ± 10%; 100 V
C56	21-82372C07	.05 uF ± 80-20%; 25 V
C57	21-82187B14	.001 uF ± 10%; 100 V
C58	21-859937	24
C59		NOT USED
C60	21-82372C03	0.1 uF ± 80-20%; 25 V
C61		NOT USED
C62	8-11017A03	.0022 uF ± 5%; 50 V
C63	21-82372C03	0.1 uF ± 80-20%; 25 V
C64	21-82537D22	.560 uF ± 5%; 100 V
C65	21-82372C07	.05 uF ± 80-20%; 25 V
C66	21-82187B14	.001 uF ± 10%; 100 V
C67	21-82372C07	.05 uF ± 80-20%; 25 V
		diode: (see note)
CR1		NOT USED
CR2	48-83654H01	silicon
CR3		NOT USED
CR4	48-83654H01	silicon
CR5	48-84616A01	silicon
		coil, rf:
L1, 2	24-82549D41	choke: 100 uH
		transistor: (see note)
Q1	48-869570	NPN; type M9570
Q2, 3		NOT USED
Q4, 5	48-869570	NPN; type M9570
Q6	48-869528	NPN; type M9528
Q7, 8	48-869570	NPN; type M9570
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1 thru 5	6-11009C83	27k
R6	6-11009C65	4.7k
R7	6-11009C83	27k
R8	6-11009C49	1k
R9, 10, 11	6-11009C83	27k
R12	6-11009C73	10k
R13	6-10621B84	1.00k ± 1%; 1/8 W
R14	8-83175C03	10k ± 1%
R15	6-10621C63	5.11k ± 1%; 1/8 W
R16	8-83175C03	10k ± 1%
R17	18-83452F14	variable; 10k
R18	6-10621C27	2.15k ± 1%; 1/8 W
R19	6-10621D88	100k ± 1%; 1/8 W
R20	6-84444A75	110k ± 1%; 1/8 W
R21	18-83452F14	variable; 10k
R22	6-10621C75	8.81k ± 1%; 1/8 W
R23	6-10621D88	100k ± 1%; 1/8 W
R24	6-10621A97	100 ± 1%; 1/8 W
R25	6-10621D58	100k ± 1%; 1/8 W
R26, 27	6-11009C83	27k
R28	6-11009C73	10k
R29	6-10621C70	6.04k ± 1%; 1/8 W
R30	6-11009C61	3.3k
R31	6-10621C63	5.11k ± 1%; 1/8 W
R32	6-10621D42	33.2k ± 1%; 1/8 W
R33	6-10621C70	6.04k ± 1%; 1/8 W
R34	6-11009C43	560
R35		NOT USED
R36	6-11009C43	560
R37	6-11009C73	10k
R38, 39	6-10621C53	4.02k ± 1%; 1/8 W
R40	18-83452F14	variable; 10k
R41	6-11009C75	12k
R42	18-83452F01	variable; 2k
R43		NOT USED
R44	6-11009C83	27k
R45	6-11009C27	5.6k
R46, 47	6-11009C63	3.9k
R48	6-11009C74	11k
R49, 50	6-11009C91	56k
R51	6-11009C73	10k
R52	6-11009C83	27k
R53, 54	6-10621D84	90.9k ± 1%; 1/8 W
R55	6-11009C74	11k
R56	6-11009C77	15k
R57, 58, 59	6-10621D58	46.7k ± 1%; 1/8 W
R60	6-11009D14	470k
R61, 62, 63	6-10621D58	46.7k ± 1%; 1/8 W
R64, 65	6-11009C81	22k
R66	6-11009D08	220k
R67	6-11009C15	36
R68	6-11009C80	20k
R69	6-11009C85	33k
R70	6-11009C80	3k
R71	6-11009C83	27k
R72	6-11009C59	2.7k
R73, 74	6-11009C01	10
R75	6-11009C99	110k
R76		NOT USED
R77	6-124B30	2.2 meg.
R78, 79	6-11009C49	1k
R80	6-11009C73	10k
R81	6-11009C49	1k
R82	6-11009C83	27k
R83	6-10621C70	6.04k ± 1%; 1/8 W
R84	6-10621C53	4.02k ± 1%; 1/8 W
R85 thru 88	6-11009C83	27k
R90	6-11009C73	10k
R91, 92	6-11009C65	4.7k
R93, 94	6-11009C56	2k
R95	6-11009C66	5.1k
R96	6-11009C63	3.9k
R97		NOT USED
R98	6-11009C73	10k
R99		NOT USED
R100	6-11009C43	560
R101		NOT USED
R102	18-83452F09	variable; 1k
R103	6-11009C97	100k
R104	6-11009C80	3k
R105	6-11009C45	680
R106	6-11009C49	1k
RT101	6-80378A45	**thermistor:** 20k @ 25°C
		integrated circuit: (see note)
U1	51-84561L41	1 of 8 decoder
U2	51-84561L48	quad 1 of 2 MUX
U3	51-82884L26	4-bit, up/down counter
U4	51-82864L51	quad AND gate
U5	51-82884L13	dual D flip-flop
U6	51-82864L04	quad NOR gate
U7	51-82864L03	hex inverter
U8	51-80365A30	32-bit counter
U9	51-80365A28	A/D converter
U10	51-82609M56	octal driver
U11	51-84561L77	hex driver
U12	51-80365A27	operational amplifier
U13	51-82884L13	dual D flip-flop
U14	51-82609M17	octal flip-flop
U15	51-82884L54	dual 4 to 1 multiplexer
U16	51-84561L75	quad operational amplifier
U17	51-82884L65	triple 2 to 1 multiplexer
U18	51-80365A07	dual operational amplifier
U19	51-82849M19	hex Schmitt trigger
U20, 21, 22	51-80365A07	dual operational amplifier
U23	51-82884L13	dual decode counter
U24	51-82884L13	dual D flip-flop
U25	51-82864L46	quad analog switch
U26	51-80365A31	PLL
		voltage regulator: (see note)
VR1	51-80365A11	Zener
VR2		NOT USED
VR3	48-82256C15	Zener; type, 5.1 V
		mechanical parts
	45-80395A41	EJECTOR (GRN); 2 used
	26-80378A78	SHIELD
	9-84881F01	SOCKET; 24 contact
	9-84881F06	SOCKET; 18 contact
	84-80378A33	CIRCUIT BOARD

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

COUNTER BOARD

MODEL RTL4106A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



NOTES:

1. Unless otherwise indicated, all resistors are in ohms, all capacitors are microfarads, and all inductors are microhenries.
2. IC types are TTL and CMOS devices.
3. Integrated circuit connections for this board are as follows:

Reference Designation	Mfgr's Description	+12 V	+5 V	Pwr GND	Sig GND	-5 V	-12 V
U1	1 of 8 Decoder		16	8			
U2	Quad 2 to 1 Multiplier		16	8			
U3	4 Bit Up/Down Counter		16	8			
U4	Quad AND Gate		14	7			
U5, U13, U24	Dual D Flip Flop		14	7			
U6	Quad NOR		14	7			
U7	Hex Inverter		14	7			
U8	32 Bit Counter		18	9			
U9	A/D Converter		19	10			
U10	Octal Buffer		20	10			
U11	[illegible]		16	8			
U12	[illegible]		7				
U14	[illegible]		20	10			
U15	Dual 4-to-1 Multiplexer		16			8 N	7
U16	[illegible]	4					4
U17	Triple 2-to-1 MUX/Driver		16			8 N	7
U18, 20, 21, 22	[illegible]	0					4
U19	[illegible]		14	7			
U23	[illegible]		14	7			
U25	[illegible]		14	7			
U26	[illegible]	16		8			

RF MODULE
MODEL RTL1048B

1. DESCRIPTION

1.1 The rf module is comprised of four sections: (1) wideband amplifier board, (2) rf wattmeter board, (3) rf interconnect board, and (4) rf mechanics. The rf mechanics include a feedthrough plug assembly (P7A & B) that interconnects the three printed circuit boards on a casting; a 0-70 dB Rotary STEP Attenuator with associated coaxial cable; two bottom covers and an RF VERNIER control.

1.2 Electrically, the rf module provides four primary rf functions: (1) high level generate (HI GEN) provides an rf output signal (AM, FM, or CW; 200 kHz-1 GHz) adjustable over the +13 dBm to −75 dBm (1.0 V to 40 uV) range; (2) low level generate (GEN) provides an rf output signal, as above for HI GEN, adjustable over the −48 dBm to −134 dBm (890 uV to .045 uV) range; (3) power monitor (PWR MON) provides a means of rf power measurement (1 MHz-1 GHz; 0.5-125 W @ ±10% accuracy), and (4) sensitive monitor (SENS MON) provides a means of "off the air" reception. The rf module also provides the necessary signal routing, analog signals for system processing, the status/control signals for each of the four functions, via an interface cable to the system control bus on the main interconnect board.

2. THEORY OF OPERATION
(Refer to functional block diagram and schematic diagrams)

2.1 RTL4095B RF INTERCONNECT BOARD

2.1.1 General

This printed circuit board provides the main interface to the system bus through a 24-pin ribbon cable and plug (J302).

2.1.2 Control Functions

2.1.2.1 U301 decodes address information and selects the network to read or drive the data bus (through J302), whenever $\overline{\text{STROBE 1}}$ goes low (enabled). Address 1100 (A3-AØ) selects two-thirds of U302, 1101 selects U303 and one third of U302 and 1110 selects U304. When the first portion of U302 is selected, the $\overline{\text{TEMP}}$ status and PROTECT signals (from the rf wattmeter board) appear on DØ and D7 of the data bus, respectively. The 0 and 10 positions of the Rotary STEP Attenuator position indicator switch (S1) appear on DØ and D1, respectively, and the 20 through 70 positions appear on D2 through D7, when the second portion of U302, and U303, are selected.

2.1.2.2 Resistors R301, R302, and R305-R312 provide pull-up current for the inputs of U302 and U303. Switch S1 is mounted on the rear shaft of the Rotary STEP Attenuator. When S1 is not in the 0 dB position, transistor Q303 is biased on and DS301 provides a visual indication of this condition to the user. When U304 is enabled via U301, the system mode functions are latched in to define the configuration of the wideband amplifier board, the rf wattmeter board, and the GEN ON/OFF condition. When U304, Q4 output is low, transistors Q302 and Q301 in turn are biased on, thus providing the switched +5 volts required to power the wideband amplifier board in both HIGH and LOW LEVEL GENERATE.

2.1.3 PROM Operation

2.1.3.1 A fused-link PROM U305 is used to provide module calibration data to the system microprocessor in the power monitor (PWR MON) and both high and low level generate (HI GEN and GEN) functions. The PROM is organized as two banks of 16 8-bit words. The four address lines (A3-AØ) select one of the 16 words of memory, while one of the two banks is selected by the latched WATTMETER ENABLE line of U304. When the power monitor (PWR MON) function has been selected, the WATTMETER ENABLE line is set high, addressing one-half of the PROM.

2.1.3.2 As the computer requires data, $\overline{\text{STROBE 3}}$ goes low (enabled), turning on transistor Q304 and providing +5 volts to U305-16. When the WATTMETER ENABLE line is low, the generate (GEN) func-

tion is implied and the other half of the PROM is available to be read by the microprocessor. The PROM is factory programmed uniquely for each rf module during final test and *must always remain with that particular unit.*

2.1.4 RF Output/Modulation Control

2.1.4.1 Potentiometer R320 is the RF VERNIER control and provides a variable dc voltage to the wideband amplifier board (J301-16), resulting in a 16 dB (minimum) range of rf output level in both high and low level generate (HI GEN and GEN). In the CW or FM generate modes, pin 18 of J302 "floats" and has no effect on the operation of the control.

2.1.4.2 However, in the AM mode, both modulating audio and a dc level shift are present at J302-18, resulting in a downward shift of the rf output level by approximately 4 dB. This is required to minimize distortion at high modulation levels. Since both the dc and audio levels are controlled by this potentiometer, the percentage of modulation tends to remain constant as the rf level is varied. Capacitors C332 and C333 and resistor R319 provide audio frequency compensation.

2.1.5 DC Voltage Distribution

Each power supply line (+5 V, +12 V, & −12 V) is filtered on this board before distribution to the other boards in the module. The LO/HI BAND (J302-15), CAR & MOD LEVEL OUT (J302-16), ALC (J302-14) and POWER METER (J302-17) are all analog signals and are not processed on this board.

2.2 RTL4094A RF WATTMETER BOARD

2.2.1 Detector, Differential, and Summing Amplifiers

2.2.1.1 In the power monitor (PWR MON) function rf power from the radio under test, is applied to J101, and attenuated by a 14 dB, 125 W attenuator AT101. This reduced power level is applied to 50-ohm load AT102 through relay K101. The peak of the voltage produced across the load is detected by diode CR105 and the resulting dc level is applied to a three-stage instrumentation style amplifier U101A, C, and D.

2.2.1.2 Thermistor RT101 provides compensation for changes in the internal temperature of the compartment, while diode CR107 and operational amplifier U101A provide temperature compensation for diode CR105. The detected signal is amplified by U101C, the output of which is summed in U101D, differentially with the output of the reference amplifier U101A. The signal at the output of U101D is passed directly through the rf interconnect board to the analog interface board for additional processing. Because of the diode detector CR105, this output signal is directly proportional to the square of the power applied. Potentiometer R143 provides Offset adjustment, while R122 provides Gain adjustment. For 125 watts of input power, the 50 ohm load AT102 dissipates only 5 watts, with the balance absorbed by the 14 dB, 125 watt attenuator AT101.

2.2.2 RF Switch and Over Power Protection

2.2.2.1 Operational amplifier U102 (connected as a comparator) and transistors Q101 and Q102 are used to provide control of relays K101 and K102. Since Q101 provides an inverting signal to Q102, relay K101 is always energized when K102 is not (exclusive OR configuration). This condition is forced: (1) if the system microprocessor causes the latched WATTMETER ENABLE line to go high, or; (2) the detector network, consisting of diodes CR101 and CR109 responds (through resistor R132) to an rf voltage at the input to AT101. The dc level produced from either source is summed at pin 2 of U102; U102 output goes low and turns off transistor Q101 (and thus relay K102) and enables relay K101 via transistor Q102.

2.2.2.2 Diodes CR108 and VR101 act to speed up the opening of relay K102's contacts should condition (2) above occur. Also, under this condition, transistor Q101 causes the PROTECT line output signal to go high, which informs the system microprocessor that rf power may have been applied to J101, while the FUNCTION switch was set to other than the PWR MON position. Also, in the PWR MON function, capacitive coupling around relay K102 allows enough signal to pass through J102 to enable the receiver to monitor the modulation on the rf power source.

2.2.2.3 In the sensitive monitor (SENS MON) or high level generate (HI GEN) functions, relay K101 is set the same as for PWR MON, via the WATTMETER ENABLE line. Also, relay K103 is closed, since the system microprocessor sets the latched ANTENNA ENABLE line high, turning on transistor Q103. In the former case, signals present at the ANTENNA connector (J6 on the front panel) are routed to J106, through relay K103 to J102, through the Rotary STEP Attenuator AT3 and finally to the first mixer on the wideband amplifier board. Likewise, in the high level generate (HI GEN) function, a signal generated by the wideband amplifier board is routed to ANTENNA connector J6.

2.2.3 Over Temperature Protection

The 14 dB, 125 watt attenuator AT101 is capable of dissipating 125 watts for approximately two minutes, at which time the temperature of the device exceeds the 100° C temperature rating. Thermistor RT102, resting on the head of one of the attenuator flange mounting screws, decreases in resistance to a point that causes the output of comparator U101B to go low. This signal

causes the microprocessor to activate the service monitor audible alarm and disable certain functions until the applied rf power is removed and AT101 has had ample time to cool off.

2.3 RTL4093A WIDEBAND AMPLIFIER BOARD

2.3.1 General

The wideband amplifier board performs essentially two functions: First, in the generate (GEN and HI GEN) functions, the board amplifies a −10 dBm ±5 dB signal from the rf synthesizer module, providing an rf output signal of uniform and level response in the 200 kHz-1 GHz range. This signal in the high level generate (HI GEN) function is in the +13 dBm to −5 dBm range (using the RF VERNIER control with the Rotary STEP Attenuator AT3 set to 0 dB). This range may be extended to −75 dBm (using the Rotary STEP Attenuator AT3 set to 70 dB). Likewise, in the low level generate (GEN) function, the signal is in the −48 dBm to −64 dBm range (using the RF VERNIER control and the built-in 14 dB attenuator AT101 on the RF wattmeter board with the Rotary STEP Attenuator AT3 set to 0 dB). This range may be extended to −134 dBm (using the Rotary STEP Attenuator AT3 set to 70 dB). Second, in the sensitive monitor (SENS MON) function, this board in conjunction with the receiver board enables the reception of "off the air" AM, FM or CW signals in the 1 MHz-1 GHz spectrum.

2.3.2 Control Inputs

This section executes the desired front panel functions available on the service monitor. Comparator U209 sets up the correct circuit conditions for the low and high level generate (GEN and HI GEN), and power monitor and sensitive monitor (PWR MON and SENS MON) functions, and provides buffered inputs for all four control lines. In HI GEN, U209D-14 goes high; in GEN, U209B-7 goes high and in PWR MON/SENS MON, U209C-8 goes high. When the rf synthesizer frequency is operating below 1 MHz, the LO/HI BAND line, U209A-1 goes high. This forces U210, via diode CR205, high for maximum gain in the rf amplifier chain and also activates U208A which routes the ALC error voltage produced by U206A over to the rf synthesizer leveling circuits via the ALC line. In addition, U208D switches in additional rf bypassing for the detectors at these lower frequencies.

2.3.3 RF Amplifier, HI GEN Switch & 30 dB Attenuator

2.3.3.1 The rf amplifier chain is comprised of hybrid devices U201-U205. The overall gain (when all five devices are active) is approximately 25 dB.

2.3.3.2 Devices U201 and U202 are active in all four functions (HI GEN, GEN, PWR MON and SENS MON). The HI GEN switching transistor Q206 turns on and applies voltage to devices U203-U205 in all functions except GEN. In the GEN function, transistor Q206 turns off, thereby removing voltage from stages U203-U205. Also, the 30 dB attenuator (R229, R230, R248 and R249) is switched in series with the GEN output path to further reduce the signal.

2.3.4 HI GEN Detector, GEN Detector, & Level Control

2.3.4.1 In the HI GEN function, when all amplifier stages are active, the HI GEN detector (CR217, C222, and L220) is also active, providing a dc voltage to the automatic leveling control (ALC) circuits. Since in this case, amplifier U203 is enabled (through transistor Q206), U203-1 has approximately 1.0 volt of dc bias. This back biases GEN detector diode CR231 as it is also biased (in part) by the same network (R266, R272 and R223) as the HI GEN detector.

2.3.4.2 In the GEN function, when only amplifier stages U201-202 are active, amplifier U203 input bias drops to 0 volts. This allows the GEN detector diode CR231 to become slightly forward biased thereby producting a dc voltage to the ALC circuits. Also, an additional dc biasing network (CR232, VR205, R283 and R284) is switched in via comparator U209B-7 output going high. This improves performance at the lowest levels of rf output because of an increase of forward biased diode CR231.

2.3.4.3 The outputs of both detectors are summed together at a high gain operational amplifier U207; U207 output is varying as a function of the rf level in either HI GEN or GEN. This output is routed via the CAR & MOD LEVEL OUT line to the analog interface board. The microprocessor processes this signal, along with the Rotary STEP Attenuator switch position data from the rf interconnect board, to display the correct rf output level (in dBm or microvolts) being produced, as well as any amplitude modulation that may be present on the rf carrier. The same output signal is also one of the two signals applied to summing amplifier U206A.

2.3.4.4 The AM MOD AUDIO signal from the rf interconnect board passes through analog gate U208C (switched on in either HI GEN or GEN by U209D or U209B, respectively) to amplifier U206B, and is the second signal to be summed at U206A. The output of U206A is therefore proportional to the level set by the RF VERNIER control and the detected rf level generated. The second signal becomes the reference for the first and acts to set the desired rf level. This output of U206A (through amplifier/buffer U210 and Q207), provides bias to a PIN diode attenuator network CR206, U207, and CR208 that essentially varies the gain of the rf amplifier line up.

2.3.5 Mixer, Matching Network & I-F Amplifier

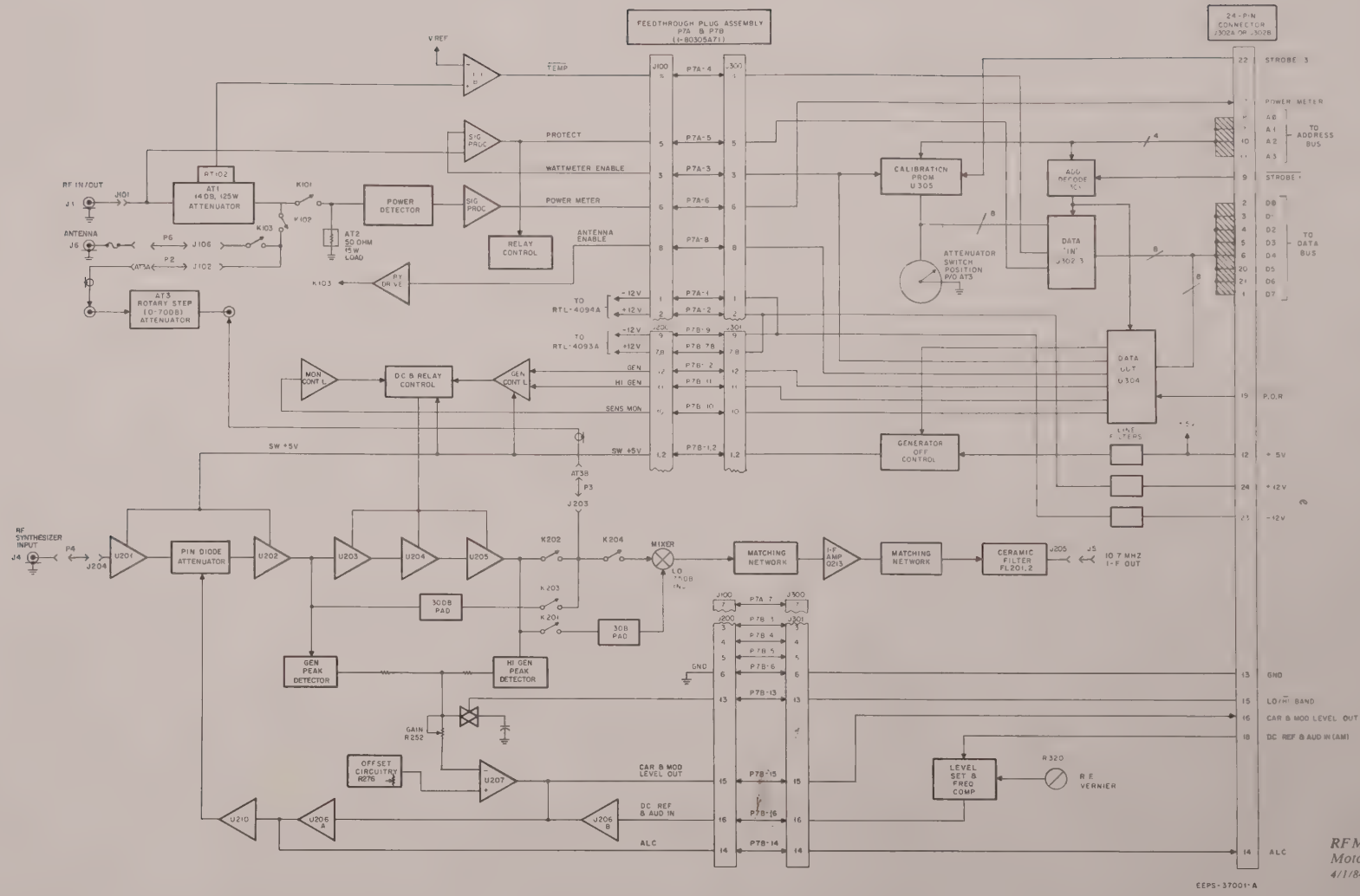
2.3.5.1 Mixer E201 is a passive, double balanced type mixer and is employed only in the PWR MON and SENS MON functions. Diodes CR222 and CR223 will clamp excessive rf levels present at the mixer rf input port. The mixer injection signal is supplied from the rf synthesizer module, amplified to + 10 dBm by devices U201-U205 and attenuated by a 3 dB pad (R277, R278 and R279) to approximately 7 dBm. The mixer injection level is fixed at +7 dBm by resistor R211 supplying a fixed bias on the D.C. REF & AUD IN line via analog switch U208B, thereby indirectly controlling the bias on the PIN diode attenuator to provide constant rf amplifier gain. The injection frequency is *always* 10.7 MHz above or below (high or low side injection, respectively) the rf input signal such that a 10.7 MHz i-f output signal results from the mixing process.

2.3.5.2 Matching network (C228, C229 and L212) is a tunable filter that matches the mixer 50 ohm output port to the high impedance presented by Q213 gate.

2.3.5.3 10.7 MHz i-f amplifier stage Q213 provides approximately 20 dB of gain. Capacitor C232 is variable and provides a match between the relatively high drain output impedance of Q213 and the low termination impedance required at the ceramic filter input. Ceramic filters, FL201 and FL202, provide wide-band filtering of the 10.7 MHz i-f signal.

2.3.6 RF Switching

The HI GEN and GEN signals are routed through relays K202 and K203, respectively. In HI GEN, relays K201, K203 and K204 are open. In GEN, relay K201 is closed and relays K202 and K204 are open. In PWR MON and SENS MON, relays K201 and K204 are closed while K202 and K203 are open.

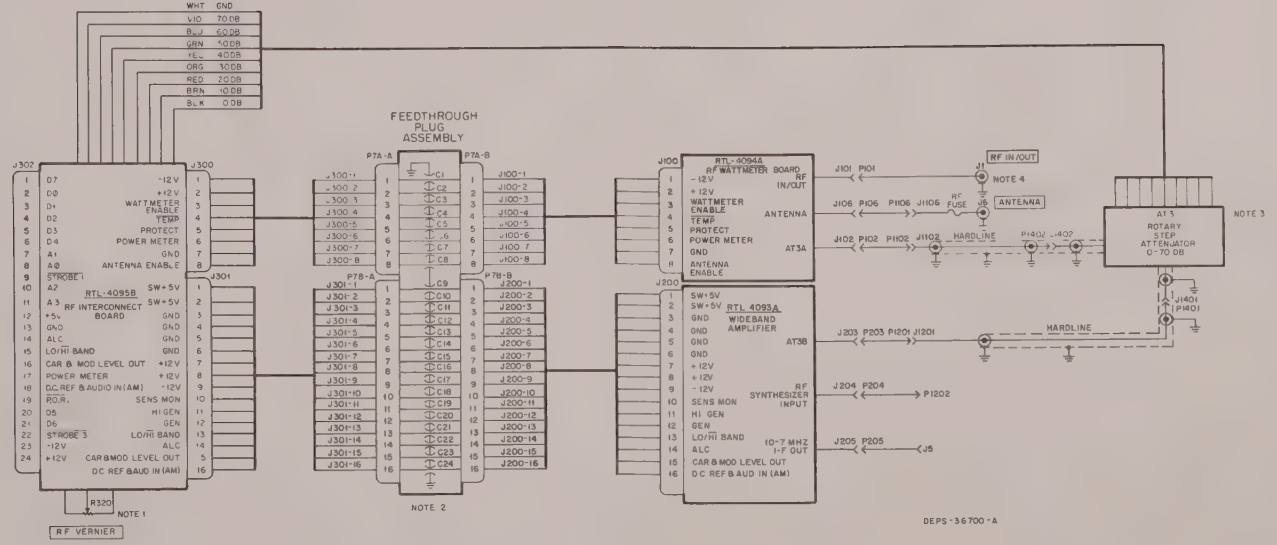


RF Module Functional Block Diagram
Motorola No. EEPS-37001-A
4/1/84-PHI

RF MODULE

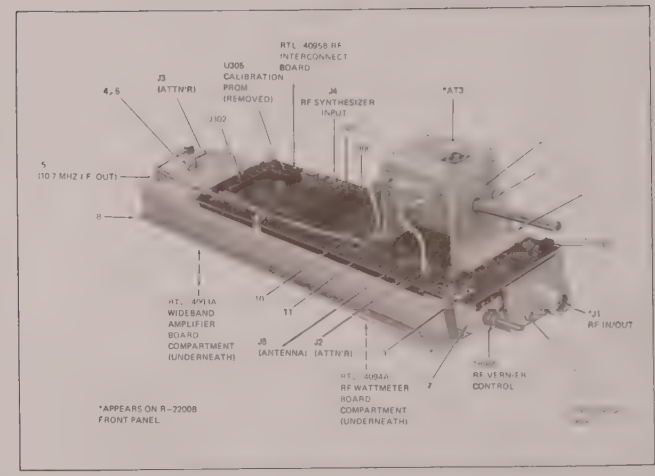
MODEL RTL1014B

INTERCONNECT DIAGRAM AND PARTS LIST



NOTES

1. R320 is a front panel control. It is physically attached to the RTL-4095B.
2. Feedthrough capacitors C1 through C24 are 470 pF.
3. Rotary step attenuator AT3 is a front panel control. It is physically attached to the RTL-1014B RF module.
4. J1 and J6 are front panel connectors.



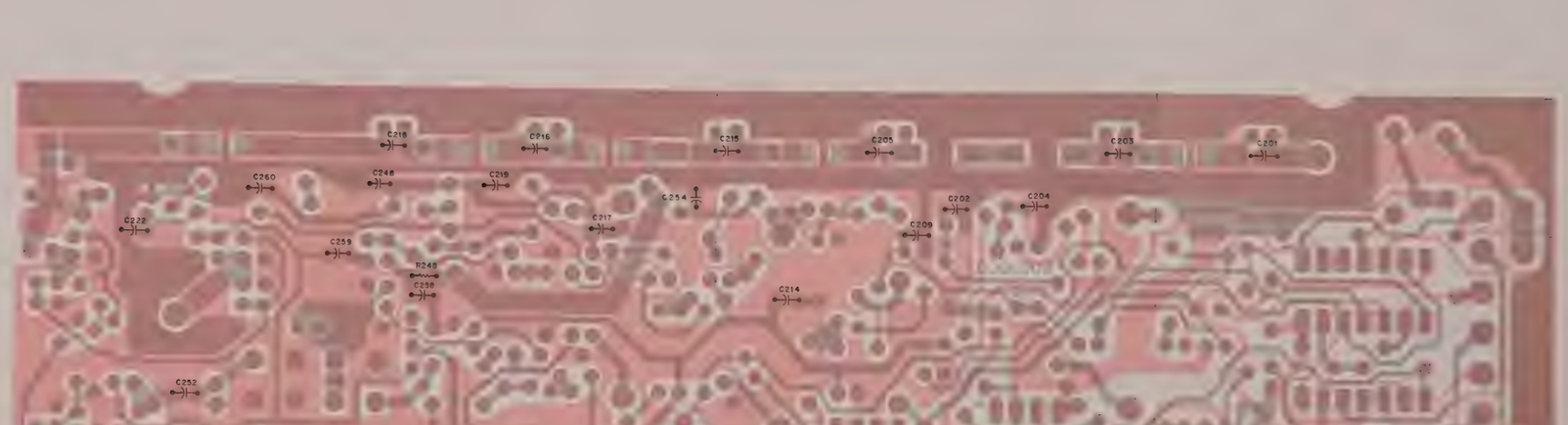
parts list

RTL1014B RF Module — PL-8480-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
P7A, P7B	1-80305A71	assembly rf feed-thru; includes:
C1 thru 24	21-84874K01	470 pF ± 20%; 250 V
	29-80377A64	PIN; 24 used
	64-80377A32	PLATE
		connector, receptacle:
J1	9-82741A01	female; single-contact
J2 thru 4	9-80377A71	female, SMB, single-contact
J5	9-84135B02	female, single-contact (phono)
J6	9-80377A71	female, SMB, single-contact
		resistor:
R320	18-80390A75	variable, 10k
		switch
S1	1-80350A18	assembly, switch; includes:
	40-80378A28	SWITCH, rotary; 8-position
ref. no.		**mechanical parts**
AT3	1-80377A74	ATTENUATOR, pot assembly
1	3-138804	SCREW, machine; 4-40 × 5/16", 8 used
2	3-139581	SCREW, machine; 4-40 × 5/16", 6 used
3	3-2942	SCREW, machine; 4-40 × 3/16" Phillips round; 4 used
4	3-136782	SCREW, machine; #2-56 × 3/16" Phillips pan; 4 used
5	4-8406	LOCKWASHER #2 internal; 27 used
6	7-80377A33	BRACKET, atten; 2 used
7	7-80390A20	BRACKET
8	64-80377A29	CASTING
9	2-131435	NUT, 4-40; 2 used
10	1-80356A04	CABLE, coaxial (long hardline)
11	1-80356A06	CABLE, coaxial (short hardline)
		non-referenced items
	3-136890	SCREW, machine; 4-40 × 9/32"; 8 used
	4-140208	LOCKWASHER #4 split; 4 used
	15-80377A30	COVER (RF WM)
	15-80377A31	COVER (WBA)
	42-80395A06	CLIP
	43-80370A69	SPACER, M/F 4-40; 2 used
	43-80395A82	STANDOFF; 2 used
	55-84300B02	HANDLE; 4 used
	14-80395A02	INSULATOR
	14-80395A03	INSULATOR
	29-82713M01	TERMINAL, 9 used

Motorola No. PEPS-37074-A
4/1/84- PHI

RF MODULE
WIDEBAND AMPLIFIER BOARD
MODEL RTL4093A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



SHOWN FROM SOLDER SIDE
(COMPONENTS ARE CHIP CAPACITORS)

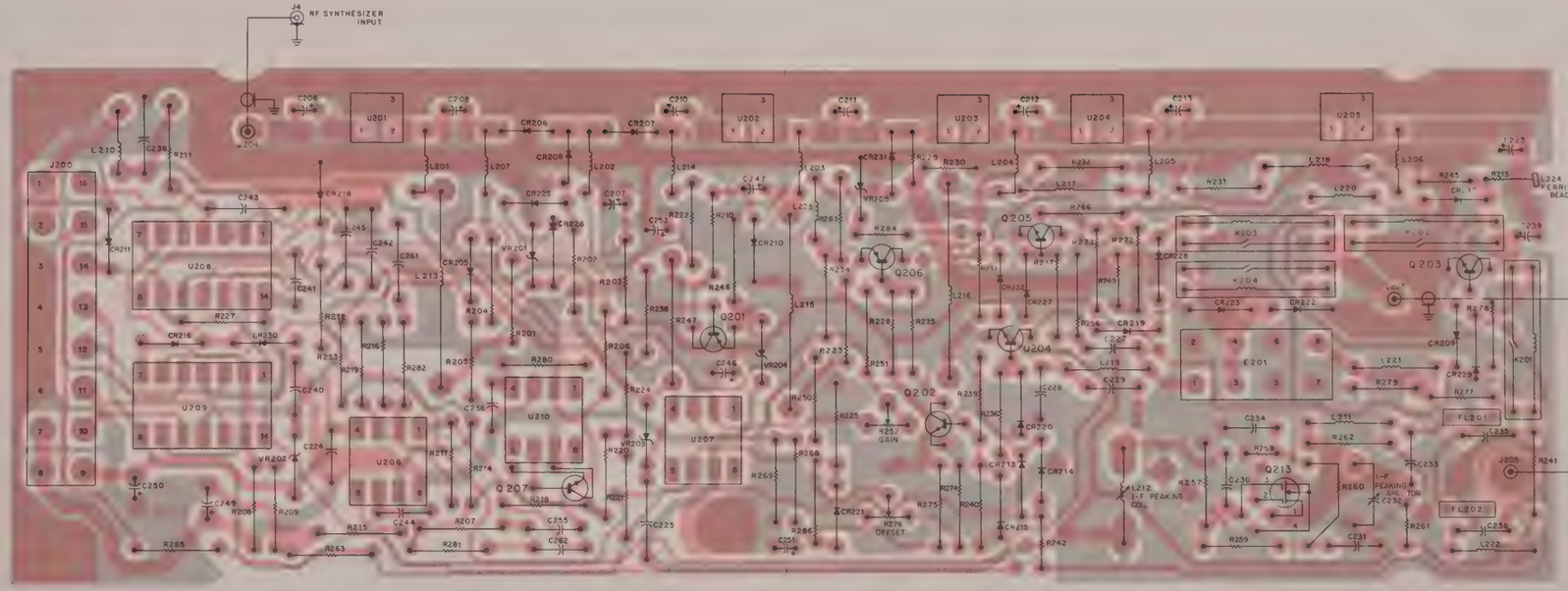
COMPONENT SIDE — 8D-EEPS-36317-O (REVERSED)
SOLDER SIDE — 8D-EEPS-36316-A (REVERSED)
OL-EEPS-36318-O

WIDEBAND AMPLIFIER BOARD

RF MODULE

WIDEBAND AMPLIFIER BOARD

MODEL RTL4093A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



SHOWN FROM COMPONENT SIDE

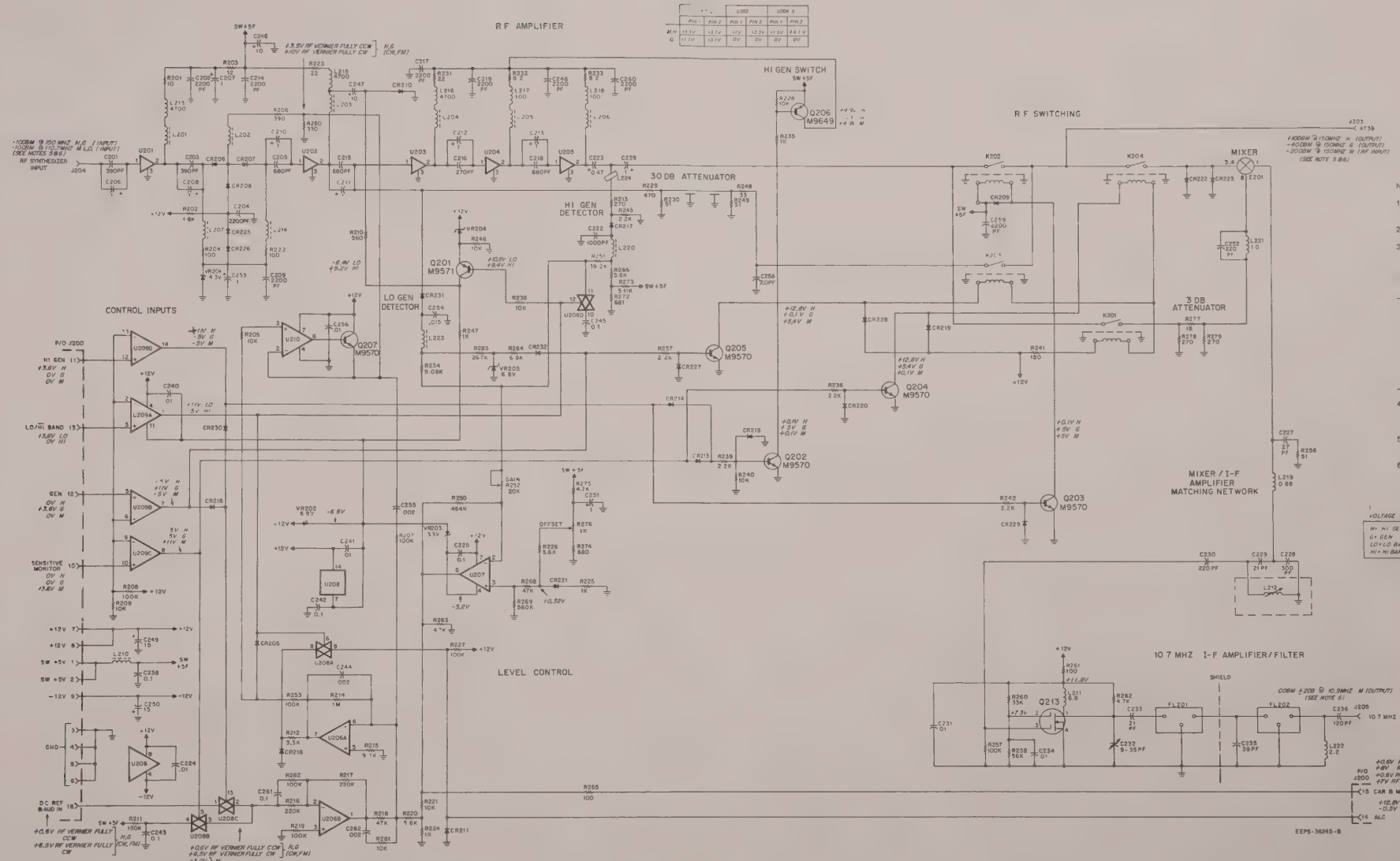
COMPONENT SIDE : 8D-EEPS-36317-O
SOLDER SIDE : 8D-EEPS-36316-A
0L-EEPS-36315-A

RF MODULE

WIDEBAND AMPLIFIER BOARD

MODEL RTL4093A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



NOTES

1. Unless otherwise indicated, all resistor values are in ohms, all capacitor values are in microfarads and all inductors are in microhenries
2. IC types are TTL & CMOS devices
3. Types and connections for the integrated circuits used on this board are as follows

Reference Designation	+5V	+12V	−12V	GND	Unused Pins	Description
U201	Filt. +5V; 2	—	—	3	—	RF Amp
U202	Filt. +5V; 2	—	—	3	—	RF Amp
U203	Filt. SW +5V; 2	—	—	3	—	RF Amp
U204	Filt. SW +5V; 2	—	—	3	—	RF Amp
U205	Filt. SW +5V; 2	—	—	3	—	RF Amp
U206	—	8	4	—	—	Dual Op-Amp
U207	—	7	—	—	1, 5, 8	Op-Amp
U208	—	14	—	—	—	Quad Analog Switch
U209	—	4	—	—	—	Quad Op-Amp (Comparator)
U210	—	7	—	4	1, 5, 8	Op-Amp

4. All dc voltages obtained with an rf synthesizer injection input (J4) being -10 dBm @ 150 MHz for HI GEN and GEN, and -10 dBm @ 110.7 MHz for MON. These voltages are typical values
5. RF output levels in the AI GEN and GEN functions are obtained by setting the RF VERNIER control.
6. LO injection input and rf input (@ J4 and J3, respectively) yield an i-f output (@ J5) as shown in the MON function

WIDEBAND AMPLIFIER BOARD

Motorola No. PEPS-36854-A
(Sheet 3 of 4)
4/1/84-PHI

RF MODULE

WIDEBAND AMPLIFIER BOARD

MODEL RTL4093A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

parts list

RTL4093A Wideband Amplifier Board — PL 8462 A

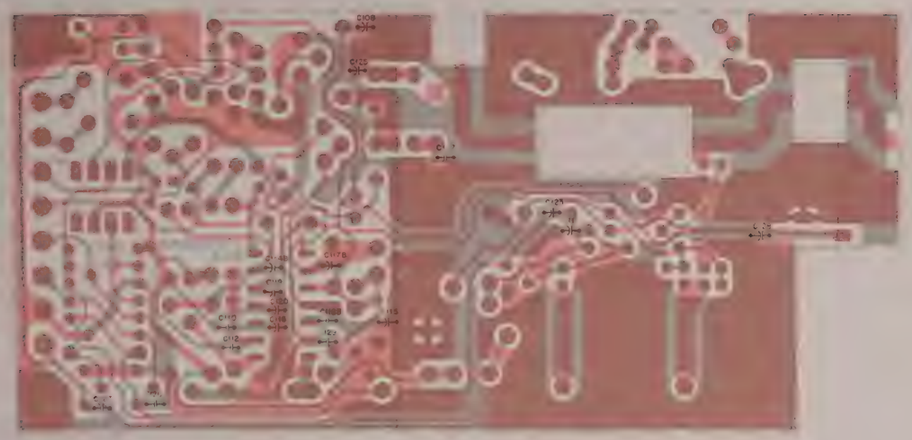
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed pF; ± 10%; 50 V (chip): unless otherwise stated
C201	21-80376A21	390
C202	21-80376A26	2200
C203	21-80376A21	390
C204	21-80376A26	2200
C205	21-80376A24	680
C206, 207, 208	23-83441B15	1 uF ± 20%; 35 V
C209	21-80376A26	2200
C210 thru 213	23-83441B15	1 uF ± 20%; 35 V
C214	21-80376A26	2200
C215	21-80376A24	680
C216	21-80376A19	270
C217	21-80376A26	2200
C218	21-80376A24	680
C219	21-80376A26	2200
C222	21-80376A25	1000
C223	23-84762H14	0.47 uF ± 20%; 50 V
C224	21-82428B21	.01 uF + 10-30%; 100 V
C225	21-82372C03	0.1 uF + 80-20%; 25 V
C226		NOT USED
C227	21-84494B42	27 ± 5%; 500 V
C228	21-84494B15	300 ± 5%, 500 V
C229	21-84494B40	21 ± 5%; 500 V
C230	21-82187B08	220 ± 10%; 500 V
C231	21-82428B21	.01 uF + 10-30%; 100 V
C232	19-80370A35	variable; 9-35 pF
C233	21-84494B40	21 ± 5%; 500 V
C234	21-82428B21	.01 uF + 10-30%; 100 V
C235	21-84494B24	39 ± 5%; 500 V
C236	21-84494B06	120 ± 5%; 500 V
C237		NOT USED
C238	21-82372C03	0.1 uF + 80-20%; 25 V
C239	23-83441B15	1 uF ± 20%; 35 V
C240, 241	21-82428B21	.01 uF + 10-30%; 100 V
C242, 243	23-82372C03	0.1 uF + 80-20%; 25 V
C244	21-82428B47	.002 uF ± 5%; 200 V
C245	21-82872C03	0.1 uF + 80-20%; 25 V
C246, 247	23-84665F01	10 uF + 100-10%; 25 V
C248	21-80376A26	2200
C249, 250	23-84665F02	15 uF + 100-10%; 25 V
C251	23-83441B15	1 uF ± 20%; 35 V
C252	21-80376A14	220 pF ± 2%
C253	23-83441B15	1 uF ± 20%, 35 V
C254	21-80376A27	.015 uF ± 10%
C255	21-82428B47	.002 uF ± 5%; 200 V
C256	21-82428B21	.01 uF + 10-30%; 100 V
C257		NOT USED
C258	21-80376A02	2.7 ± .25 pF
C259, 260	21-80376A26	2200
C261	21-82372C03	0.1 uF + 80-20%, 100 V
C262	21-82428B47	.002 uF ± 5%; 200 V
		diode:(see note)
CR205	48-83654H01	silicon
CR206, 207, 208	48-80345A62	pin
CR209, 210, 211	48-83654H01	silicon
CR212		NOT USED
CR213 thru 216	48-83654H01	silicon
CR217	48-80394A86	hot carrier
CR218, 219, 220	48-83654H01	silicon
CR221	48-80394A86	hot carrier
CR222, 223	48-83654H01	silicon
CR224		NOT USED
CR225 thru 230	48-83654H01	silicon
CR231	48-80394A86	hot carrier
CR232	48-83654H01	silicon
		mixer:
E201	1-80377A98	assembly, double balanced mixer
		filter:
FL201, 202	91-80377A94	ceramic, 10.7 MHz
		relay:
K201 thru 204	80-80377A59	spst, coil res. 350 ohms; 5 V
		coil, rf:
L201 thru 207	24-83961B01	3 turns
L210	24-83961B01	3 turns
L211	24-80369A28	choke; 6.8 uH
L212	24-80377A97	variable
L213	24-80369A44	choke; 4700 uH
L214	24-83961B01	3 turns
L215, 216	24-80369A44	choke; 4700 uH
L217, 218	24-82549D41	choke; 100 uH
L219	24-80369A21	choke; 0.68 uH
L220	24-83961B01	3 turns
L221	24-80369A22	choke, 1 uH
L222	24-80369A32	choke; 2.2 uH
L223	24-83961B01	3 turns
L224	76-83960B01	choke, bead; 3 turns
		transistor: (see note)
Q201	48-869571	PNP; type M9571
Q202 thru 205	48-869570	NPN; type M9570
Q206	48-869649	PNP; M9649
Q207	48-869570	NPN; type M9570
Q213	48-869791	MOS field-effect
		resistor, fixed; ± 5%; 1/4 W: unless otherwise stated
R201	6-124A01	10
R202	6-124A55	1.8k
R203	6-124A03	12
R204	6-124A25	100
R205	6-124A73	10k
R206	6-124A39	390
R207, 208	6-124A97	100k
R209	6-124A73	10k
R210	6-124A43	560
R211	6-124902	150k
R212	6-124A81	3.3k
R213	6-185A35	270; 1/8 W
R214	6-124B22	1 meg
R215	6-124A72	9.1k
R216, 217	6-124B06	220k
R218	6-124A89	47k
R219	6-124A97	100k
R220	6-10621C67	5.6k ± 1%; 1/8 W
R221	6-10621C91	10k ± 1%; 1/8 W
R222	6-124A25	100
R223	6-124A09	22
R224, 225	6-124A49	1k
R226	6-124A67	5.6k
R227	6-124A97	100k
R228	6-124A73	10k
R229	6-185A41	470; 1/8 W
R230	6-185A18	51; 1/8 W
R231	6-124A09	22
R232, 233	6-124B67	8.2
R234	6-10621C87	9.09k ± 1%; 1/8 W
R235	6-124A49	1k
R236, 237	6-124A57	2.2k
R238	6-124A73	10k
R239	6-124A57	2.2k
R240	6-124A73	10k
R241	6-124A29	150
R242	6-185A57	2.2k; 1/8 W
R243, 244		NOT USED
R245	6-185A57	2.2k, 1/8 W
R246	6-124A73	10k
R247	6-125A49	1k; 1/2 W
R248	6-11024A13	33; 1/8 W (chip)
R249	6-185A18	51; 1/8 W
R250	6-10621E53	464k ± 1%; 1/8 W
R251	6-10621D49	39.2k ± 1%; 1/8 W
R252	18-83452F16	variable; 20k
R253	6-124A97	100k
R254, 255		NOT USED
R256	6-124A18	51
R257	6-124A97	100k
R258	6-124A91	56k
R259		NOT USED
R260	6-124A85	33k
R261	6-185A25	100; 1/8 W
R262, 263	6-124A65	4.7k
R264		NOT USED
R265	6-124A25	100
R266	6-124A67	5.6k
R267		NOT USED
R268	6-124A89	47k
R269	6-124B16	560k
R270, 271		NOT USED
R272	6-10621B78	681 ± 1%; 1/8 W
R273	6-10621C63	5.11k ± 1%; 1/8 W
R274	6-124A45	680
R275	6-124A65	4.7k
R276	18-83452F10	variable; 1k
R277	6-185A07	18; 1/8 W
R278, 279	6-185A35	270; 1/8 W
R280	6-124A37	330
R281	6-124A73	10k
R282	6-124A97	100k
R283	6-10621D33	26.7k ± 1%; 1/8 W
R284	6-185A69	6.8k; 1/8 W
		integrated circuit: (see note)
U201, 202, 203	51-80345A34	rf amplifier
U204, 205	51-80345A35	rf amplifier
U206	51-80365A07	dual operational amplifier
U207	51-80365A08	operational amplifier
U208	51-82884L46	quad analog switch
U209	51-83629M08	quad operational amplifier
U210	51-83629M07	operational amplifier
		voltage regulator: (see note)
VR201	48-80378A46	Zener type; 4.3 V
VR202	48-82256C23	Zener type; 6.8 V
VR203, 204	48-83624E92	Zener type; 3.3 V
VR205	48-82256C23	Zener type, 6.8 V
		mechanical parts
	26-80378A77	SHIELD
	26-80395A49	SHIELD
J203, 204	9-5856A01	SOCKET, spring miniature; 2 used
J200	9-80377A65	RECEPTACLE, pin; 2 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers

RF MODULE

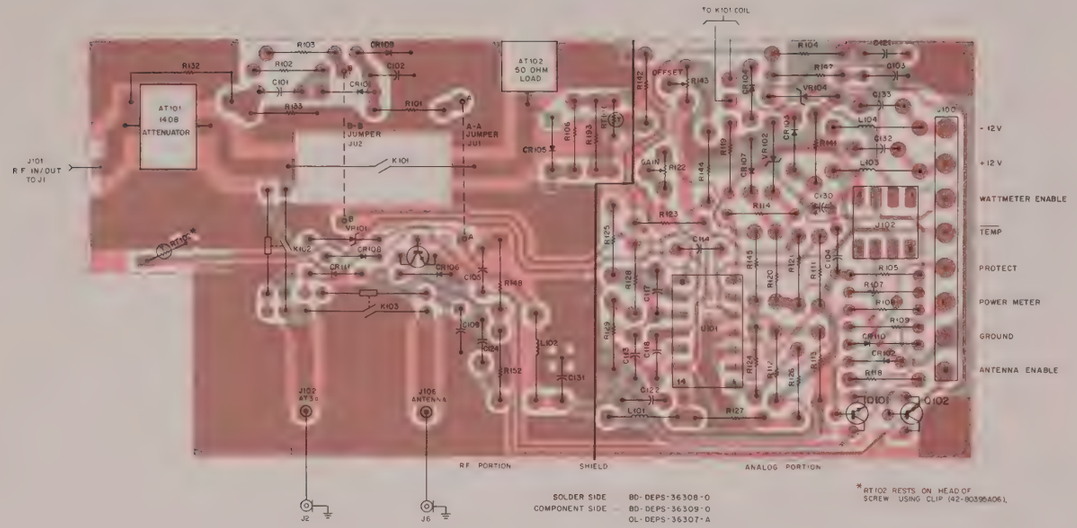
RF WATTMETER BOARD

MODEL RTL4094A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



SOLDER SIDE — 80-DEPS-36308-O REVERSED
COMPONENT SIDE — 80-DEPS-36309-O REVERSED
OL-DEPS-36310-A

SHOWN FROM SOLDER SIDE
(COMPONENTS ARE CHIP CAPACITORS)



SHOWN FROM COMPONENT SIDE

parts list

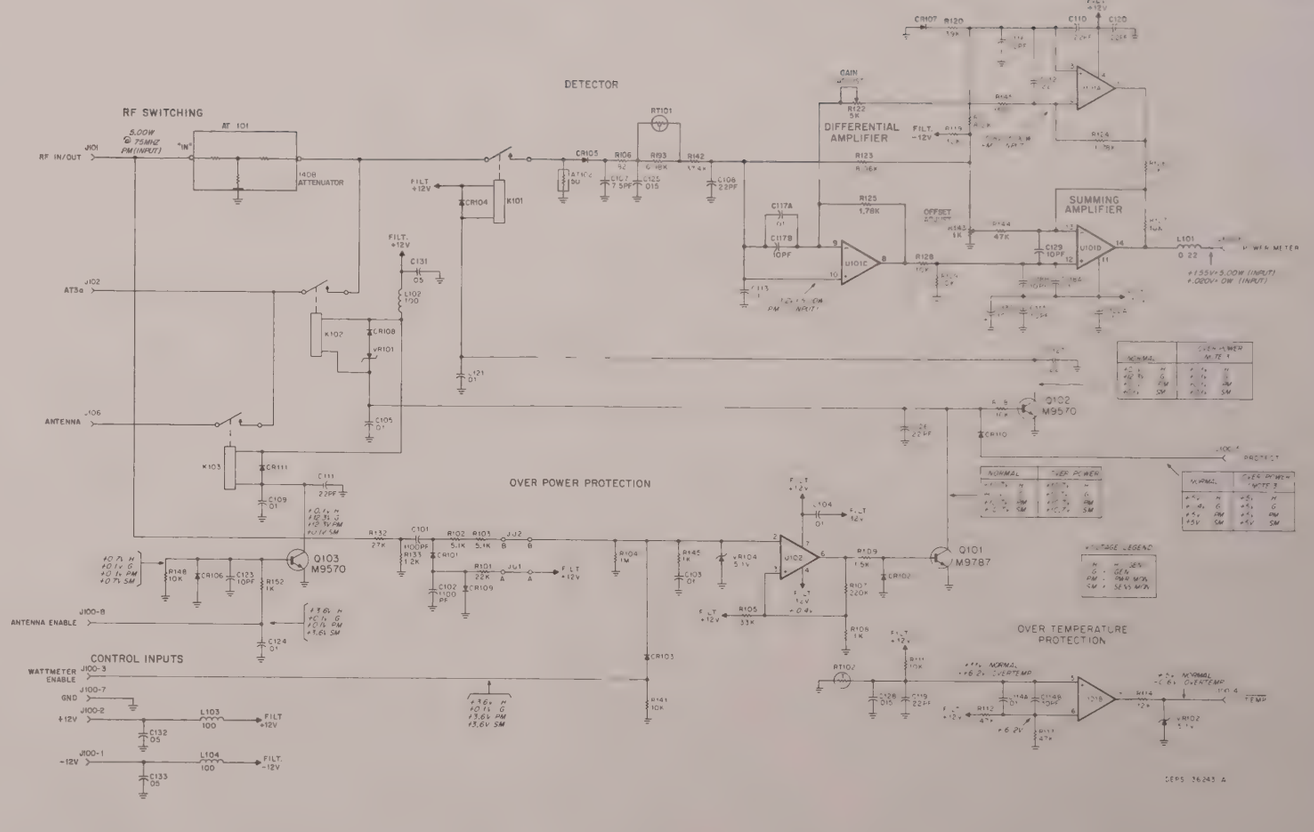
RTL4094A RF Wattmeter Board — PL-8463-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		attenuator:
AT101	17-80377A95	14 dB
AT102	17-80377A96	50 ohm termination
		capacitor, fixed pF; ± 5%; 50 V (chip):
C101, 102	21-83596E32	unless otherwise stated 1100; 200 V
C103, 104, 105	21-832501	.01 uF + 80-40%; 500 V
C106		NOT USED
C107	21-80376A28	7.5
C108	21-80376A10	22
C109	21-832501	.01 uF + 80-40%; 500 V
C110, 111, 112	21-80376A10	22
C113, 114A	21-82428B21	.01 uF + 10-30%; 100 V
C114B, 115	21-80376A06	10
C116	21-80376A10	22
C117A	21-82428B21	.01 uF + 10-30%; 100 V
C117B	21-80376A06	10
C118A	21-82428B21	.01 uF + 10-30%; 100 V
C118B	21-80376A06	10
C119, 120	21-80376A10	22
C121	21-832501	.01 uF + 80-40%; 500 V
C122A	21-82428B21	.01 uF + 10-30%; 100 V
C123	21-80376A06	10
C124	21-832501	.01 uF + 80-40%; 500 V
C125	21-80376A27	.015 uF ± 10%
C126, 127	21-80376A10	22
C128	21-80376A27	.015 uF ± 10%
C129	21-80376A06	10
C130	23-84665F01	10 uF + 100-10%; 25 V
C131, 132, 133	21-82372C07	.05 uF + 80-20%; 25 V
		diode: (see note)
CR101	48-80345A64	hot carrier
CR102, 103, 104	48-83654H01	silicon
CR105	48-80345A64	hot carrier
CR106	48-83654H01	silicon
CR107	48-80345A64	hot carrier
CR108	48-83654H01	silicon
CR109	48-80345A64	hot carrier
CR110	48-84616A01	hot carrier
CR111	48-83654H01	silicon
		relay:
K101		Includes
	24-80369A45	solenoid
	26-80377A63	shield, reed
	40-84200B02	switch, reed, spst
K102, 103	80-80377A60	1 form A res. 1500 ohms
		coil, rf:
L101	24-80369A25	choke; 0.22 uH
L102, 103, 104	24-82549D41	choke; 100 uH
		transistor: (see note)
Q101	48-869787	NPN; type M9787
Q102, 103	48-869570	NPN; type M9570
		resistor, fixed; ± 5%; 1/4 W:
		unless otherwised stated
R101	6-124A81	22k
R102, 103	6-124A66	5.1k
R104	6-124B22	1 meg
R105	6-124A85	33k
R106	6-124A23	82
R107	6-124B06	220k
R108	6-124A49	1k
R109	6-124A53	1.5k
R110		NOT USED
R111	6-124A73	10k
R112, 113	6-124A89	47k
R114	6-124A75	12k
R116	6-124A73	10k
R119	6-124A75	12k
R120	6-124A87	39k
R121	6-124A71	8.2k
R122	18-84352F12	variable; 5k
R123	6-83175C90	6.06k ± 1%; 1/8 W
R124, 125	6-10621C19	1.78k ± 1%; 1/8 W
R126 thru 129	6-83175C03	10k ± 1%; 1/8 W
R132	6-125A83	27k; 1/2 W
R133	6-124A51	1.2k
R141	6-124A73	10k
R142	6-83175C51	37.4k ± 1%; 1/8 W
R143	18-83452F10	variable; 1k
R144	6-124A89	47k
R145	6-124A53	1.5k
R147	6-124A49	1k
R148	6-124A73	10k
R152	6-124A49	1k
R153	6-83175C88	6.98k ± 1%; 1/8 W
		thermistor:
RT101, 102	6-83600K05	100k @ 25°C

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		integrated circuit: (see note)
U101	51-83629M08	quad operational amplifier
U102	51-83629M07	operational amplifier
		voltage regulator: (see note)
VR101	48-80345A84	Zener type; 68 V
VR102	48-82256C15	Zener type; 5.1 V
VR103		NOT USED
VR104	48-82256C15	Zener type; 5.1 V
		mechanical parts
J102, 106	9-05856A01	SOCKET, spring miniature; 2 used
J100	9-80377A65	RECEPTACLE, pin
	26-80378A76	SHIELD
	26-80377A63	SHIELD, reed

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

RF MODULE
RF WATTMETER BOARD
MODEL RTL4094A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



NOTES

1. Unless otherwise specified, resistor values are in ohms, all capacitor values are in microfarads, and all inductor values are in microhenries.
2. IC types are TTL & CMOS devices.
3. 1.25 W TRIP POINT @ J101 for overpower condition.
4. Types and connections for the integrated circuits used on this board are as follows:

Reference Designation	Mfgrs Description	+ 12 V	- 12 V	Gnd	Unused Pins
U101	Quad Op Amp	4	11	–	–
U102	Op Amp	7	4	–	1 5 8

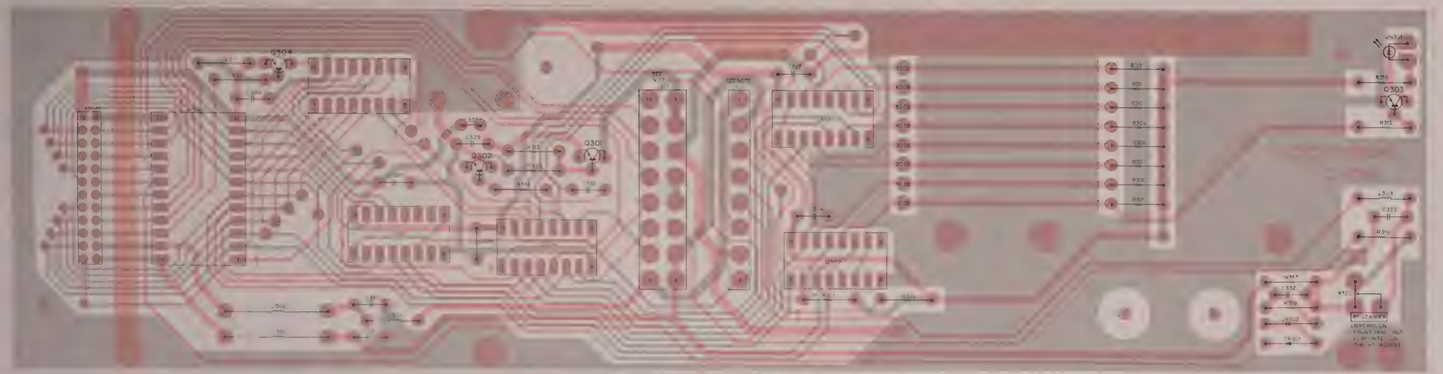
Motorola No. PEPS-36853-A
(Sheet 2 of 2)
4 1 84- PHI

RF WATTMETER BOARD

RF MODULE

RF INTERCONNECT BOARD

MODEL RTL4095B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST


Q304
Q302
Q301
Q303
U301
U302
U303
U304
U305
J300
J302A
J302B
J303
SEE NOTE
SEE NOTE
SEE NOTE

RF MODULE

RF INTERCONNECT BOARD

MODEL RTL4095B

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

NOTES

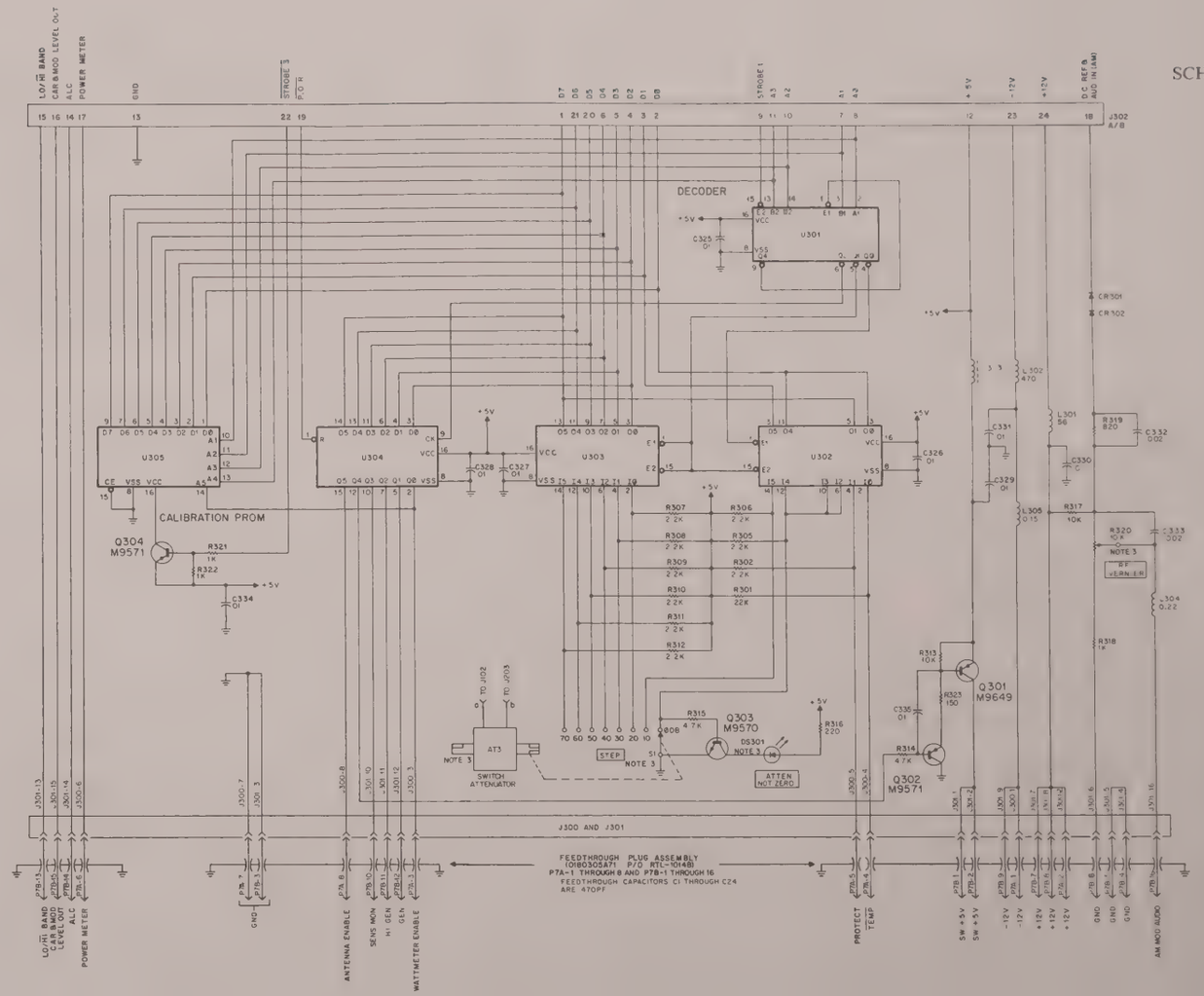
1. Unless otherwise indicated, all resistor values are in ohms, capacitor values are in microfarads, and inductor values are microhenries
2. IC types are TTL & CMOS devices
3. Part mounted on board, but extends thru front panel when module is installed
4. Types and connections for the integrated circuits used on this board are as follows

Reference Designation	Mfgr's Description	+5V	Gnd	Unused Pins
U301	Decode/Demux	16	8	7, 10, 11, 12
U302	Hex 3-State Buffer	16	8	7, 9
U303	Hex 3-State Buffer	16	8	—
U304	Hex D-Flip-Flop	16	8	—
U305	Prom	16	8	—

Truth Table RTL-4095B

	Module Write		Module Enable		Strobe				Data							
Mode	A0	A1	A2	A3	S0	S1	S2	S3	D0	D1	WEN D2	GEN D3	HIGEN D4	MON D5	CENOFF D6	AEN D7
HI GEN	0	1	1	1	0	⎍	0	0	0	0	1	0	1	0	0	1
GEN	0	1	1	1	0	⎍	0	0	0	0	0	1	0	0	0	0
MON	0	1	1	1	0	⎍	0	0	0	0	1	0	0	1	1	0
SENS MON	0	1	1	1	0	⎍	0	0	0	0	1	0	0	1	0	1

	Module Read		Module Enable	
TEMP	0	0	1	1
PROTECT	0	0	1	1
ATTEN 0-70	0	0	1	1



RF INTERCONNECT BOARD

Motorola No. PEPS-36852-A
(Sheet 2 of 2)
4/1/84- PHI

TONE SYNTHESIZER BOARD

MODEL RTL4096A

1. DESCRIPTION

1.1 The tone synthesizer generates audio frequencies in the 10 Hz to 9999 Hz range. Frequency selection is controlled by the service monitor's microprocessor and the output of the crystal controlled 5.12 MHz oscillator.

1.2 The tone synthesizer is comprised of an address decoder, 2.56 MHz clock generator, digital-to-analog converter, harmonic filters, and frequency multipliers.

2. THEORY OF OPERATION

2.1 ADDRESS DECODER

Input lines AØ through A3 contain the address of the upper or lower frequency registers and the control latch. The dual 2-to-4 decoder is activated by the $\overline{\text{STB2}}$ signal. Level shifters U3 and U4 convert data bus logic to +12 V logic.

2.2 CLOCK GENERATOR

The output of the 5.12 MHz crystal controlled oscillator is buffered by transistor Q3 and divided by the dual-D flip-flop U25A to obtain a symmeterical 2.56 MHz clock pulse. The upper two digits of the selected frequency are latched into U6 and U7, and the lower two digits are latched into U8 and U9. The outputs of the latches are sent to the bit rate multipliers. U14 and U15 are fixed frequency dividers. U16 selects one of the four available frequencies.

2.3 DIGITAL-TO-ANALOG CONVERTER

The actual frequency output of analog switch U16 is 32 times greater than the desired frequency. A 5-bit counter comprised of U14, U17, and Q5 applies the counter output to an exclusive OR gate tree made up of U18, U19, and U20. The decoded outputs are applied to summing amplifier U21 where the square waves are synthesized into a sine wave.

2.4 HARMONIC FILTERS

A low-pass filter formed by U16, U21, and U23 is used to suppress unwanted harmonics. The filter cutoff frequency is determined by the analog switches under microprocessor control. The output frequencies available are determined by the selected frequency range.

2.5 SIGNAL SELECTION AND OUTPUT

For normal tone generation, analog switch U22 selects unattenuated filter output, and for tone remote signaling the attenuated output is selected. The attenuator, formed by U21B and U22A, provides 10 dB and 30 dB attenuation. Amplifier U24 provides signal gain and buffering. A lowpass filter removes any high frequencies components of the synthesized frequency.

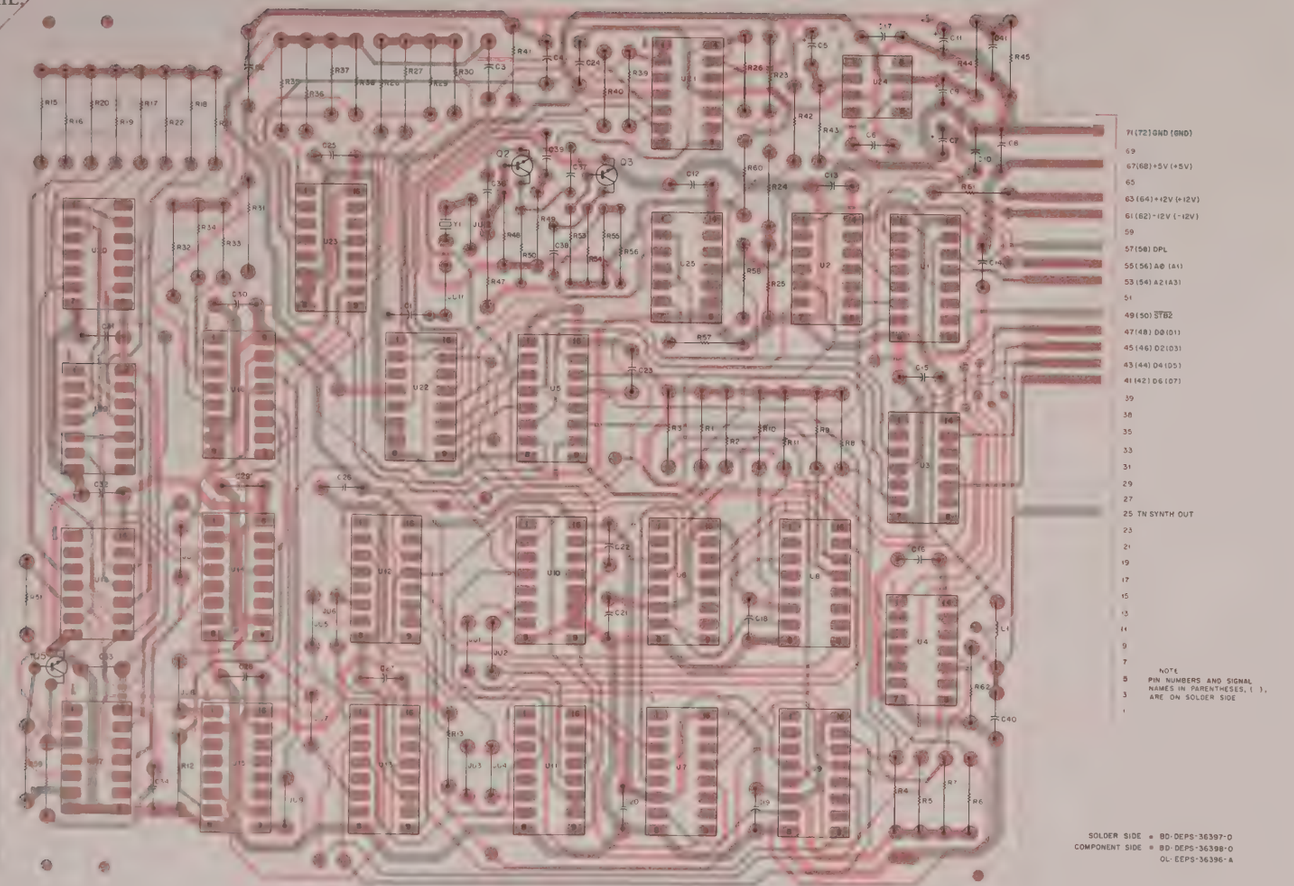
2.6 DPL GENERATION

The *Digital Private-Line* (DPL) signal is generated by software and sent to the harmonic filters via U21 and switch U22.

TONE SYNTHESIZER BOARD

MODEL RTL4096A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



SOLDER SIDE = BD-DEPS-36397-O
COMPONENT SIDE = BD-DEPS-36398-O
OL-EEPS-36396-A

SHOWN FROM COMPONENT SIDE

Motorola No. PEPS-36855-A
(Sheet 1 of 2)
4/1/84- PHI

parts list

RTL4096A Tone Synthesizer Board — PL-8459-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed: uF; ± 100-10%; 25 V: unless otherwise stated
C1	21-840849	20 pF ± 5%; 500 V
C2	21-863291	1500 pF ± 2%; 500 V
C3	21-82537B49	3900 pF ± 1%; 100 V
C4	21 865956	220 pF ± 3%; 500 V
C5	23-84665F26	100; 16 V
C6	21-82428B21	.01 + 10-30%; 100 V
C7	23-84665F01	10
C8	21-82428B21	.01 + 10-30%; 100 V
C9	23-84665F01	10
C10	21-82428B21	.01 + 10-30%; 100 V
C11	23-84665F01	10
C12	21-82372C03	0.1 + 80-20%; 25 V
C13 thru 34	21-82428B21	.01 + 10-30%; 100 V
C35		NOT USED
C36	21-865452	680 pF ± 10%, 500 V
C37, 38	21-82187B20	001 ± 10%, 100 V
C39	21 865922	390 pF ± 10%, 500 V
C40	21-82187B20	001 ± 10%, 100 V
C41	21-82428B21	.01 + 10-30%; 100 V
		coil, rf:
L1	24-82549D03	choke; 1000 uH
		transistor: (see note)
Q1		NOT USED
Q2, 3	48-869570	NPN; type M9750
Q4		NOT USED
Q5	48-869570	NPN; type M9570
		resistor, fixed ± 5%; 1/4 W: unless otherwise stated
R1 thru 11	6-11009C83	27k
R12, 13	6-11009C49	1k
R14		NOT USED
R15	6-80334A58	4.99k ± 1%
R16	6-80334A63	12.1k ± 1%
R17	6-80334A62	60.4k ± 1%
R18	6-80334A57	619k ± 1%
R19	6-80334A61	24.9k ± 1%
R20	6-80334A56	2.55k ± 1%
R21	6-80334A60	51.1k ± 1%
R22	6-80334A55	121k ± 1%
R23	6-11009C85	33k
R24	6-11009C79	18k
R25	6-11009C88	43k
R26	6-11009C49	1k
R27	6-80334A64	715k ± 1%
R28	6-80334A59	68.1k ± 1%
R29	6-11009C73	10k
R30	6-11009C67	5.6k
R31	6-80334A64	715k ± 1%
R32	6-80334A59	68.1k ± 1%
R33	6-11009C73	10k
R34	6-11009C67	5.6k
R35	6-80334A64	715k ± 1%
R36	6-80334A59	68.1k ± 1%
R37	6-11009C73	10k
R38	6-11009C67	5.6k
R39	6-11009D09	300k
R40	6-11009C73	10k
R41	6-11009D01	130k
R42	6-11009C77	15k
R43	6-11009C82	24k
R44, 45	6-83175C03	10k ± 1% 1/8 W
R46		NOT USED
R47	6-11009C72	9.1k
R48	6-11009C80	20k
R49	6-11009C49	1k
R50	6-11009C42	510
R51, 52	6-11009C83	27k
R53	6-11009D14	470k
R54	6-11009C65	4.7k
R55, 56	6-11009C97	100k
R57, 58	6-11009C49	1k
R59	6-11009C65	4.7k
R60	6-11009C13	33
R61	6-11009C01	10
		integrated circuit: (see note)
U1	51-84561L42	dual decoder
U2, 3, 4	51-83627M04	quad open collector NAND gate
U5	51-82884L70	hex flip-flop
U6, 7, 8, 9	51-82884L15	quad latch
U10, 11, 12, 13	51-83627M59	4-bit BCD rate multiplier
U14	51-82884L07	dual binary counter
U15	51-82884L12	dual BCD counter
U16	51-82884L54	dual 4 to 1 multiplexer
U17	51-82884L13	dual D flip flop
U18, 19, 20	51-82884L49	quad exclusive OR gate
U21	51-84561L75	quad operational amplifier
U22	51-82884L65	triple 2 to 1 multiplexer
U23	51-82884L54	dual 4 to 1 multiplexer
U24	51-84561L80	operational amplifier
U25	51-82884L13	dual D flip-flop

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		crystal: (see note)
Y1	48-80378A43	5.12 MHz
		mechanical parts
	45-80395A36	EJECTOR (ORG); 2 used
	14-84602K01	INSULATOR
	84-80377A87	PC BOARD

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

TONE SYNTHESIZER BOARD

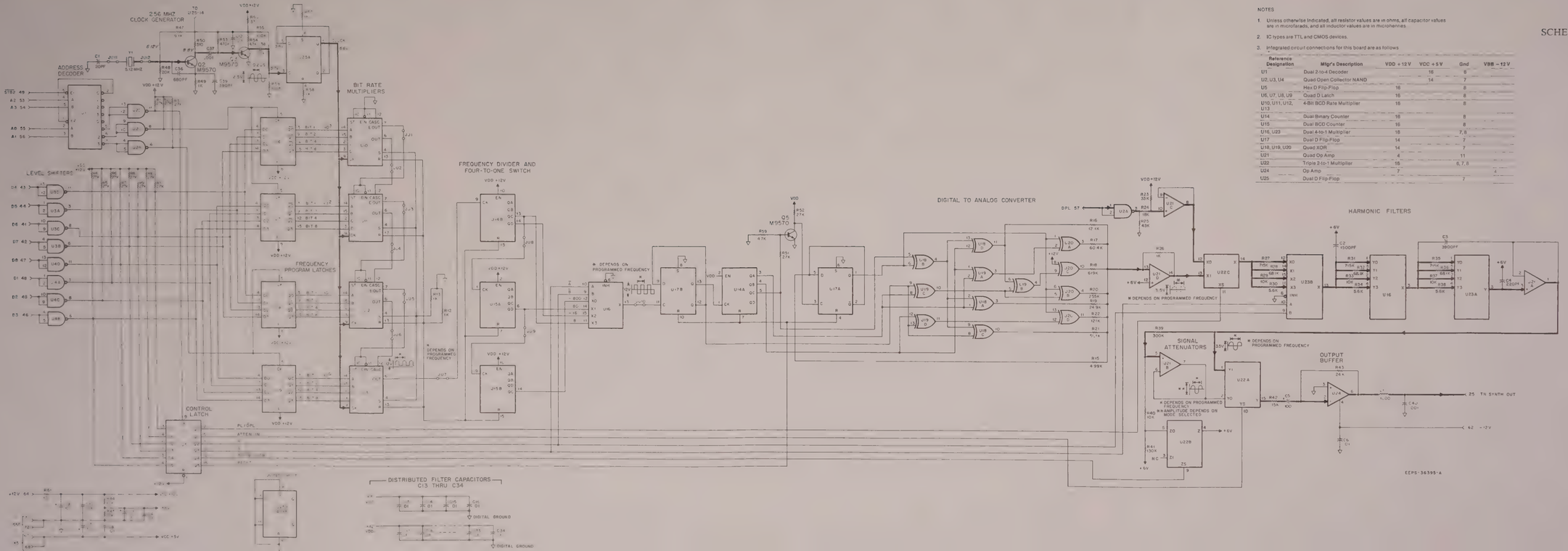
MODEL RTL4096A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

NOTES

1. Unless otherwise indicated, all resistor values are in ohms, all capacitor values are in microfarads, and all inductor values are in microhenries.
2. IC types are TTL and CMOS devices.
3. Integrated circuit connections for this board are as follows:

Reference Designation	Mfgr's Description	VDD +12 V	VCC +5 V	Gnd	VBB −12 V
U1	Dual 2-to-4 Decoder		16	8	
U2, U3, U4	Quad Open Collector NAND		14	7	
U5	Hex D Flip-Flop	16		8	
U6, U7, U8, U9	Quad D Latch	16		8	
U10, U11, U12, U13	4-Bit BCD Rate Multiplier	16		8	
U14	Dual Binary Counter	16		8	
U15	Dual BCD Counter	16		8	
U16, U23	Dual 4-to-1 Multiplier	16		7,8	
U17	Dual D Flip-Flop	14		7	
U18, U19, U20	Quad XOR	14		7	
U21	Quad Op Amp	4		11	
U22	Triple 2-to-1 Multiplier	16		6,7,8	
U24	Op Amp	7			4
U25	Dual D Flip-Flop			7	



Motorola No. PEPS-36855-A
(Sheet 2 of 2)
4/1/84- PHI

TONE SYNTHESIZER BOARD

MOTOROLA INC.
Communications
Sector

REFERENCE/AUDIO MODULE (TCXO/OCXO)

MODELS RTL4097A/RTL4098A

1. DESCRIPTION

The reference/audio module consists of the TCXO/OCXO board and the audio/speaker board. The reference/audio module contains: (1) the 10 MHz time base for the service monitor, (2) the audio amplifier and (3) the speaker. A standard (RTL4097A) temperature compensated crystal oscillator (TCXO) provides ±1 PPM stability. An optional (RTL4098A) oven compensated crystal oscillator (OCXO) is available which provides ±0.05 PPM stability over temperature variations.

2. THEORY OF OPERATION

2.1 TCXO/OCXO BOARD

Oscillator E1 generates a 10 MHz signal that is coupled to operational amplifier U1. The output of U1A is two 10 MHz signals 180° out-of-phase. The oscillator is driven by +5 volts supplied through a pi-filter.

2.2 AUDIO AMPLIFIER BOARD

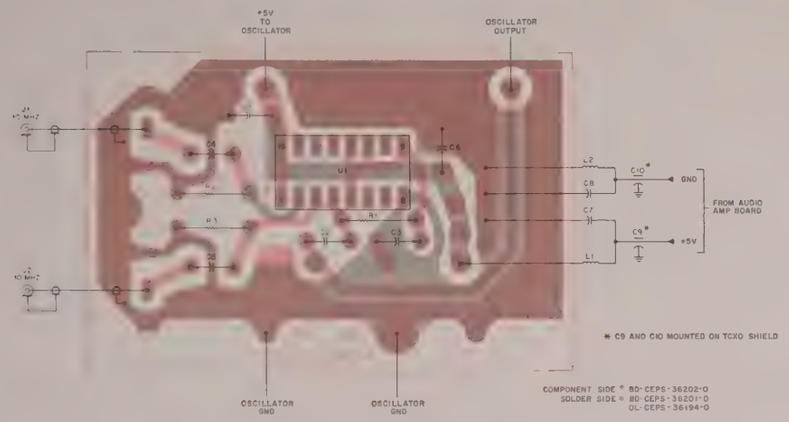
Audio is applied through buffer amplifier U1B and a driver circuit to the speaker. The output of U1 is buffered by transistor Q1, and the signal amplified by push-pull amplifier Q2 and Q3. The amplifier circuit is powered by a +12 volt source.

technical writing services
1301 E. Algonquin Road, Schaumburg, Il. 60196

REFERENCE/AUDIO MODULE (TCXO/OCXO)

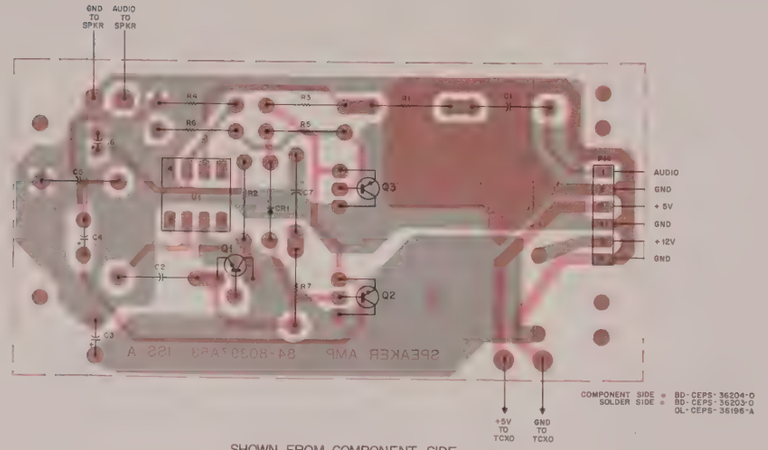
MODELS RTL4097A (TCXO)
RTL4098A (OCXO)
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

TCXO/OCXO BOARD



SHOWN FROM COMPONENT SIDE

AUDIO AMPLIFIER BOARD



SHOWN FROM COMPONENT SIDE

parts list

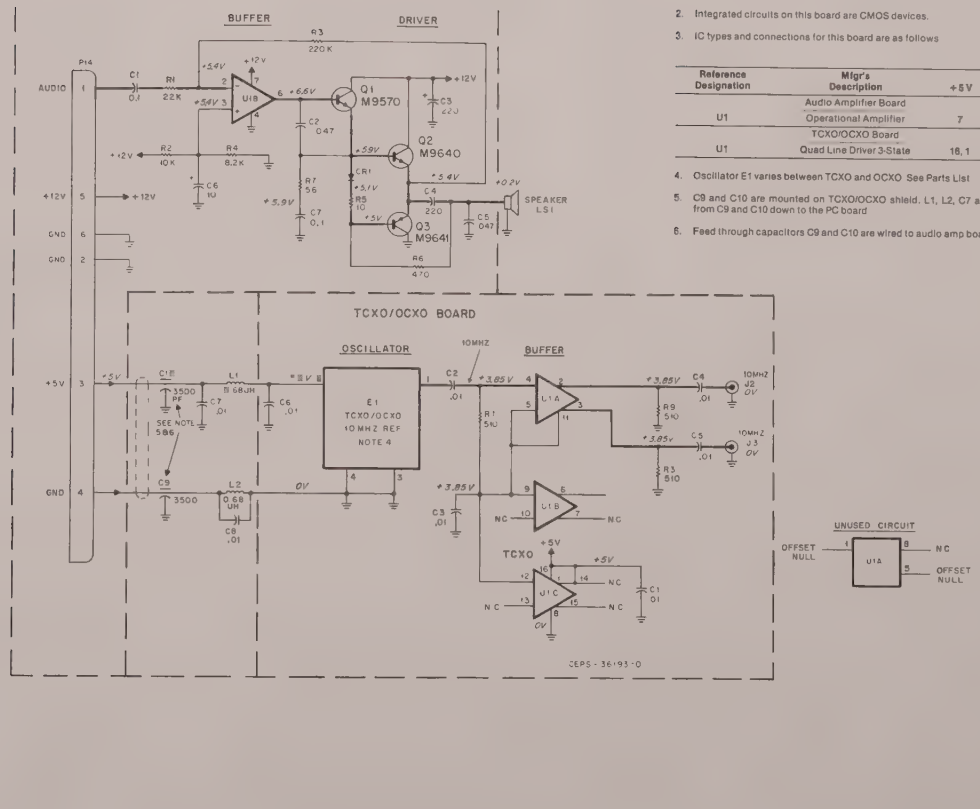
RTL4097A TCXO Module
RTL4098A OCXO Module — PL-8443-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		Audio Amplifier Board
		capacitor, fixed: uF + 80-20%; 50 V: unless otherwise stated
C1	21-84448K03	0.1
C2	21-84448K05	.047
C3, 4	23-84665F06	220 uF + 150-10%; 25 V
C5	21-84448K05	.047
C8	23-84665F01	10 uF + 100-10%; 25 V
C7	21-84448K03	0.1
		diode: (see note)
CR1	48-83654H01	silicon
		connector:
P14	28-80312B80	male; 6-contact
		speaker:
LS1	50-83064J01	16 ohm
		transistor: (see note)
Q1	48-859570	NPN, type M9570
Q2	48-859640	NPN, type M9640
Q3	48-859641	PNP, type M9641
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1	6-124A81	22k
R2	6-124A73	10k
R3	6-124B06	220k
R4	6-124A71	8.2k
R5	6-124A01	10
R6	6-124A41	470
R7	6-124A19	56
		integrated circuit: (see note)
U1	51-84371K60	high slew-rate operational amplifier
		TCXO/OCXO Board
		capacitor, fixed:
C1 thru 8	21-832501	.01 uF + 80-40%; 250 V
C9, 10	21 84211B03	3500 pF, GMV, 500 V (feed thru)
		oscillator:
E1	1-80308A92	10 MHz (RTL4097A only)
	1-80308A93	10 MHz (RTL4098A only)
		connector:
J2, 3	9-84231B02	female, single-contact (phono)
		coil, rf:
L1, 2	24-82549D17	choke; 0.88 uH
		resistor, fixed: ± 5%; 1/4 W: unless otherwise stated
R1, 2, 3	6-124A42	510
		integrated circuit: (see note)
U1	51-80365A02	quad line driver
		mechanical parts
	2-7019	NUT, 4-40 × 1/4 × 3/32"; 4 used
	3-136785	SCREW, machine; 4-40 × 3/16"; 4 used
	3-139579	SCREW, machine; 4-40 × 5/16"; 2 used
	3-139581	SCREW, machine; 4-40 × 5/18"; 2 used
	3-131435	NUT, 4-40 × 1/4 × 3/32"; 5 used
	3-136886	SCREW, machine; 4-40 × 3/8"
	3-121047	SCREW, machine; 4-40 × 5/16; 2 used
	2-131865	NUT; 1/4-28 × 3/8 × 3/32"; 2 used
	7-80378A54	BRACKET
	7-80378A55	BRACKET
	26-80378A86	SHIELD
	29-82713M01	TERMINAL; 4 used
	32-80397A59	GASKET; 2 used
	35-80313A21	GRILLE, felt
	43-80370A69	SPACER, 4 used
	43-80397A61	SPACER, 2 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers

REFERENCE/AUDIO MODULE (TCXO/OCXO)

MODELS RTL4097A (TCXO)
RTL4098A (OCXO)
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



NOTES:

1. Unless otherwise indicated: resistor values are in ohms; capacitor values are in microfarads; and inductor values are in millihenries
2. Integrated circuits on this board are CMOS devices.
3. IC types and connections for this board are as follows

Reference Designation	Mfgr's Description	+5V	Gnd
	Audio Amplifier Board		
U1	Operational Amplifier	7	4
	TCXO/OCXO Board		
U1	Quad Line Driver 3-State	16, 1	8

4. Oscillator E1 varies between TCXO and OCXO See Parts List
5. C9 and C10 are mounted on TCXO/OCXO shield. L1, L2, C7 and C8 are wired from C9 and C10 down to the PC board
6. Feed through capacitors C9 and C10 are wired to audio amp board.

MOTOROLA INC.
Communications
Sector

FRONT PANEL INTERFACE BOARD

MODEL RTL4100A

1. DESCRIPTION

The front panel interface (FPI) board provides the electrical interface between the front panel controls and displays and internal circuits. The keyboard, display module, and front panel switches are controlled via the FPI. Additional circuits on the FPI include buffering and ranging circuits for the oscilloscope input, modulation audio circuits, and the master reset.

2. THEORY OF OPERATION

2.1 KEYBOARD AND SWITCH MATRIX SCANNING

2.1.1 The front panel switch contacts (except the bandwidth switch) and the membrane keyboard contacts are arranged in a row and column matrix that is scanned by the microprocessor. The center pole of each switch is connected to the RØ-R7 lines from U1, and individual contacts on each switch are wired to lines CØ-C5. These lines are connected to +5 volts through resistors and also to the input bus of multiplexers U5 and U6.

2.1.2 Keyboard column lines KC1-KC3 are connected to the output of U2 and row lines KØ-K7 are connected to pull-up resistors and routed to the B port of U6. Four of the output lines from U2 are connected to pull-up resistors and used as load signals for output latches.

2.1.3 The microprocessor reads each row by setting address lines AØ-A3. The $\overline{\text{STBØ}}$ pulse sets the row line low and enables U5 and U6 on the data bus. Address A3 determines whether the multiplexers gate the keyboard or switch matrix data onto the bus. A low on the C- or K-lines indicates switch closure at the particular crosspoint. U5 and U6 invert the data in order to send a high to the microprocessor.

2.1.4 The microphone PTT line and the bandwidth switch are wired directly to U6. These lines are read anytime the switch matrix is addressed.

2.2 DISPLAY INTERFACE

The display interface consists of the LCD control latch, CD synthesizer mode indicator latch, and the LCD serial interface. Control lines CSA, CSB, and $\overline{\text{C}}$/D originate at the LCD control latch. Code synthesizer mode indication lines MØ-M3 are latched by U8. The parallel-to-serial converter is formed by five devices, U12, U13, U14, U15, and U31. This circuit applies the LCD CK, SCK, and SI signals. The LCD CK signal frequency is 170 kHz and is sent to both the display module and the LCD serial interface.

2.3 POWER DISTRIBUTION

Regulators U16 and U32 produce regulated ±8 volts to power the analog devices. Separate ground runners are used to minimize noise. U20B is a +7 volt reference source that is supplied to the display module and the master reset circuit.

2.4 MASTER RESET

2.4.1 The master reset circuit produces the signal that is used to initialize the service monitor on power-up. When power supplies drop below predetermined limits, the reset signal stops the microprocessor and serves to protect the battery-backed CMOS memory contents.

2.4.2 When power is first applied to the service monitor, capacitor C9 is discharged and transistor Q1 is turned on holding the $\overline{\text{P.O.R.}}$ (Power-On-Reset) low. As C9 charges, U17B switches and Q1 is turned off.

2.4.3 Comparators U17C and U17D monitor the +12 volt and +5 volt power supplies. When either voltage drops below predetermined values (+10.8 V dc or +4.7 V dc), Q6 is turned off and Q8 pulls $\overline{\text{P.O.R.}}$ low. When power is restored, Q7 discharges C9 to ensure that the proper delay occurs during reinitialization.

2.5 MODULATION AUDIO

Three sources are provided for simultaneous modulation of the rf output signal. The code synthesizer output is combined with the option card output (when installed); a filtered 1 kHz squarewave provides the fixed 1 kHz modulation source, and external modulation is provided by connecting a microphone to the front panel jack (MIC). The three level adjusted sources are combined by U23A and the composite signal is routed to the modulation display selector and the MOD line for internal distribution.

2.6 SCOPE INPUT

2.6.1 The oscilloscope step attenuator can be switched between internal audio sources and the external input. Analog switch U18 selects: (1) recovered audio when the monitor mode is selected, and (2) modulation when the GEN mode is selected. U18 is disabled when the step attenuator is connected to the external input.

2.6.2 Relays K8 and K3 are energized when the internal source is selected. K8 switches a load onto the external input when the step attenuator is being used to display modulation. K2 is energized when viewing the external input.

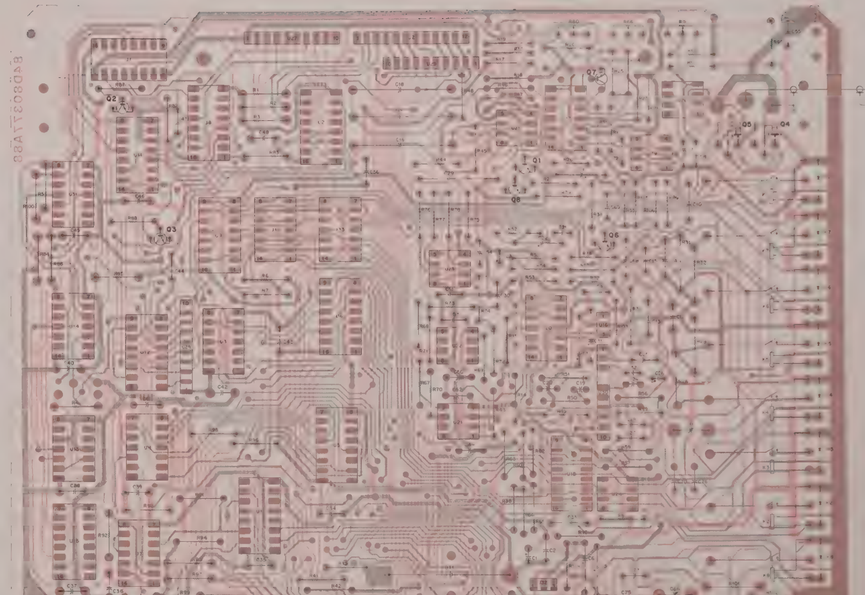
2.6.3 The step attenuator provides attenuation ranges of 1, .1, .01, and .001. The input impedance is 1 megohm with a 500 kHz bandwidth. A unity gain buffer amplifier drives the scope amplifier board. Signals controlling the modulation display selector and the scope input are latched by U8, U9, and U11. U10 and U33 drive the relays.

parts list

RTL4100A Front Panel Interface Board — PL-6460-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		battery:
BT1	RPX4258A	BATTERY; 3 V lithium
		capacitor, fixed:
C1	23-84665F01	10 uF + 100-10%; 25 V
C2	21-82428B21	.01 uF + 80-20%; 100 V
C3	23-84762H06	1 uF ± 20%; 35 V
C4	21-82428B21	.01 uF + 80-20%; 100 V
C5, 6	23-84782H06	1 uF ± 20%; 35 V
C7	21-82372C03	0.1 uF + 80-20%; 25 V
C8	21-82428B21	.01 uF + 80-20%; 100 V
C9	23-84762H06	1 uF ± 20%; 35 V
C10	8-84637L06	6800 pF ± 5%; 630 V
C11	20-34307A11	variable; 5.5..18 pF
C12	21-84494B11	200 pF ± 5%; 500 V
C13	21-859773	2500 pF ± 5%; 500 V
C14	8-84637L09	.002 uF ± 5%; 400 V
C15	21-840247	150 pF ± 5%; 500 V
C16, 17, 18	8-84285A48	.022 uF ± 1%; 50 V
C19	23-84665F01	10 uF + 100-10%; 25 V
C20	8-11017A02	.0015 uF ± 5%; 50 V
C21	21-11014B47	62 pF ± 5%; 100 V
C22	23-84762H06	1 uF ± 20%; 35 V
C23	23-84665F01	10 uF + 100-10%; 25 V
C24	8-11017A02	.0015 uF ± 5%; 50 V
C25	21-11014B47	62 pF ± 5%; 100 V
C26	23-84665F01	10 uF + 100-10%; 25 V
C27	21-82187B14	100 pF ± 10%; 100 V
C28	21-84494B24	39 pF ± 5%; 500 V
C29	8-82095J21	.33 uF ± 10%; 250 V
C30	21-84494B18	330 pF ± 5%; 500 V
C31	23-84762H06	1 uF ± 20%; 35 V
C32	8-11017A03	.0022 uF ± 5%; 50 V
C33	21-82372C03	0.1 uF + 80-20%; 25 V
C34 thru 56	21-82428B21	.01 uF + 80-20%; 100 V
C66	20-34307A11	variable; 5.5-18 pF
C67		NOT USED
C68	8-84637L04	3300 pF ± 10%; 630 V
C69	21-865923	.001 uF ± 10%; 500 V
C70	21-859838	75 pF ± 5%; 500 V
C71		NOT USED
C72	21-82187B08	220 pF ± 10%; 500 V
C73	21-859938	75 pF ± 5%; 500 V
C74		NOT USED
C75	21-84494B24	39 pF ± 5%; 500 V
C76	21-859840	20 pF ± 5%; 500 V
		diode: (see note)
CR1 thru 8	48-836541H01	silicon
		relay:
K1 thru 8	80-80346A01	1 form "A"; coil res: 1k
		transistor: (see note)
Q1, 2, 3	48-869570	NPN, type M9750
Q4, 5	48-869831	field-effect; M9831
Q6, 7, 8	48-869570	NPN, type M9750
		resistor, fixed: ± 5%; 1/4 W; unless otherwise stated
R1 2 3	6-11009C97	100k
R4	6-11009C25	100
R5	6-11009C83	27k
R6 7	6-11009C73	10k
R8	6-11009C44	620
R9	18-83452F13	variable, 10k
R10	6-11009C57	2.2k
R11	6-11009C01	10
R12	6-11009C57	2.2k
R13	6-11009C35	270
R14, 15	6-11009C73	10k
R16	6-11009C49	1k
R17	6-19621D17	18.2k ± 1% 1/8 W
R18	6-19621D42	33.2k ± 1%, 1/8 W
R19	6-19621D13	15.8k ± 1%; 1/8 W
R20	6-19621D42	33.2k ± 1%, 1/8 W
R21	6-11009C97	100k
R22	6-11009C81	22k
R23, 24	6-11009C83	27k
R25	6-11009C60	3k
R26	6-11009C59	2.7k
R27	6-11009C49	1k
R28	6-80390A80	1.82 meg ± .5%; 1/8 W
R29	6-80390A81	182k ± .5%
R30	6-80390A82	18.2k ± .5%
R31	6-80390A83	2.1k ± .5%
R32	6-80390A84	54.9k ± .5%
R33	6-11009D22	1 meg
R34	6-11009C59	2.7k
R35	6-83175C03	10k ± 1%; 1/8 W
R36	6-11009C59	2.7k
R37	6-11009C67	5.6k
R38	6-19521C72	6.34k ± 1%; 1/8 W
R39		NOT USED
R40, 41	6-11009C73	10k
R42	6-11009C44	620
R43	6-11009C73	10k
R44	6-11009C70	7.5k
R45	6-11009C69	6.8k
R46	6-19521D48	36.5k ± 1%; 1/8 W
R47	6-19521B50	348 ± 1%; 1/8 W
R48	6-19621E05	147k ± 1%; 1/8 W
R49	6-11009C47	820
R50	6-11009C43	560
R51	6-19521C62	4.99k ± 1%; 1/8 W
R52	6-11009D22	150k
R53	6-19521C12	1.5k ± 1%; 1/8 W
R54	6-19521C53	4.02k ± 1%; 1/8 W
R55	6-11009D06	220k
R56	6-11009C91	56k
R57, 58	6-11009C66	5.1k
R59	6-11009C91	56k
R60	6-19521C15	1.62k ± 1%; 1/8 W
R61	6-19521D09	15k ± 1%; 1/8 W
R62	6-19621C61	4.87k ± 1%; 1/8 W
R63	6-19621D05	13.7k ± 1%; 1/8 W
R64	6-19621C34	2.55k ± 1%; 1/8 W
R65	6-19621C17	1.84k ± 1%; 1/8 W
R66	18-83452F13	variable; 10k
R67, 68, 69	6-11009C73	10k
R70	6-11009C53	1.5k
R71, 72	6-11009C62	3.6k
R73	6-11009C29	150
R74	6-11009C68	5.6k
R75	6-11009C67	5.6k
R76, 77	6-11009C73	10k
R78	6-124038	4.7 meg ± 10%
R79	6-11009C73	10k
R80	18-83452F13	variable; 10k
R81		NOT USED
R82	6-11009C73	10k
R83	6-11009C83	27k
R84	6-11009C73	10k
R85, 86	6-11009C83	27k
R87, 88	6-11009C97	100k
R89	6-11009C43	560
R90	6-11009C71	8.2k
R91 thru 99	6-11009C83	27k
R100	6-11009C65	4.7k
R101	6-80390A80	1.82 meg ± .5%
R102	6-19621E18	200k ± 1%; 1/8 W
R103, 104	6-11009C01	10
R105	6-124854	22 meg
R106	6-11009C57	2.2k
		integrated circuit: (see note)
U1 2	51-84561L47	dual 1 of 4 decoder
U3, 4	51-84561L03	hex inverter
U5 6	51-826099M60	quad 2 to 1 multiplexer w/inverter three-state output
U7	51-82884L05	quad NAND gate
U8, 9	51-82884L70	hex D flip-flop
U10	51-83629M08	quad operational amplifier
U11	51-82884L15	quad latch
U12	51-82884L33	8 bit parallel in/serial out shift register
U13	51-82884L13	dual D flip-flop
U14	51-82884L17	triple NOR gate
U15	51-82884L35	decade counter
U16	51-80365A30	voltage regulator
U17	51-84371K74	quad comparator
U18	51-82884L54	dual 1 of 4 multiplexer
U19	51-80365A09	operational amplifier
U20	51-84561L75	quad operational amplifier
U21, 22, 23	51-80365A07	dual operational amplifier
U24	51-80365A09	operational amplifier
U25	51-80365A07	dual operational amplifier
U26	51 80365A09	operational amplifier
U27, 28 29	51 82142K06	resistor network
U30	51-82142K14	resistor network
U31	51 84561L03	hex inverter
U32	51-80365A29	voltage regulator
U33	51-83629M08	quad operational amplifier
		mechanical parts
	7-60395A57	BRACKET, (right hand)
	7-60395A58	BRACKET, (left hand)
	42-80313A70	TIE WRAP
	45-80395A35	EJECTOR (BLK); 2 used
	75-80378A90	FOOT, rubber; 2 used
	84-80377A81	CIRCUIT BOARD
	28-84726L03	CONNECTOR, male, keyboard
	9-80330A49	CONNECTOR, 16-pin
	9-83250M01	CONNECTOR, female, phono-type

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.



FRONT PANEL INTERFACE BOARD

MODEL RTL4100A

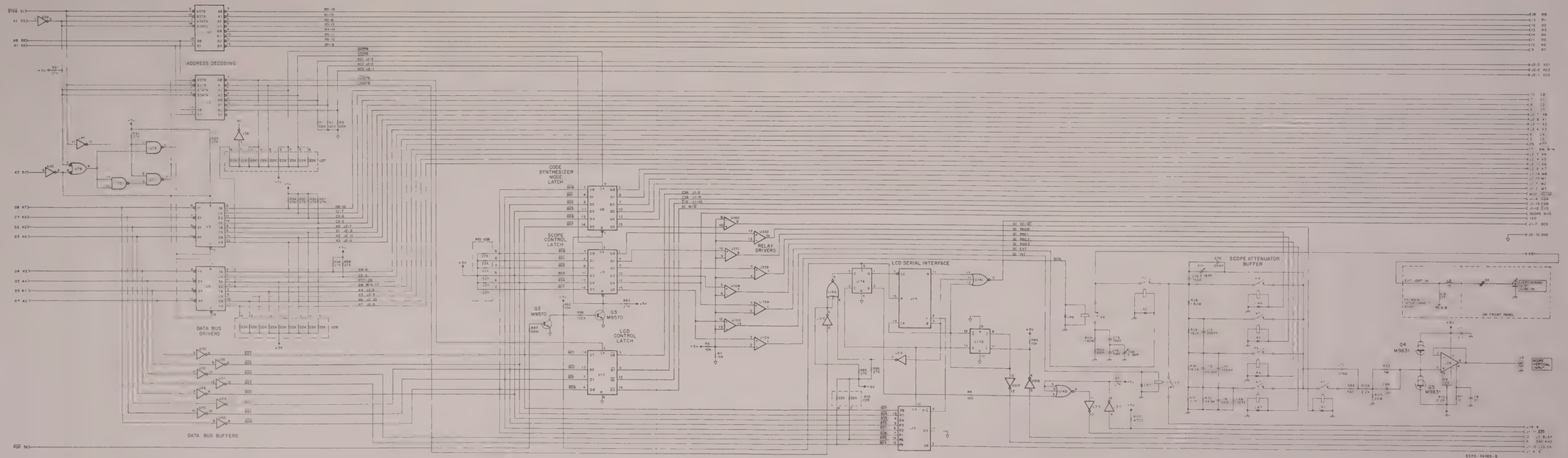
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

Motorola No. PEPS-36857-A
(Sheet 1 of 3)
4/1/84- PHI

FRONT PANEL INTERFACE BOARD

FRONT PANEL INTERFACE BOARD

MODEL RTL4100A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

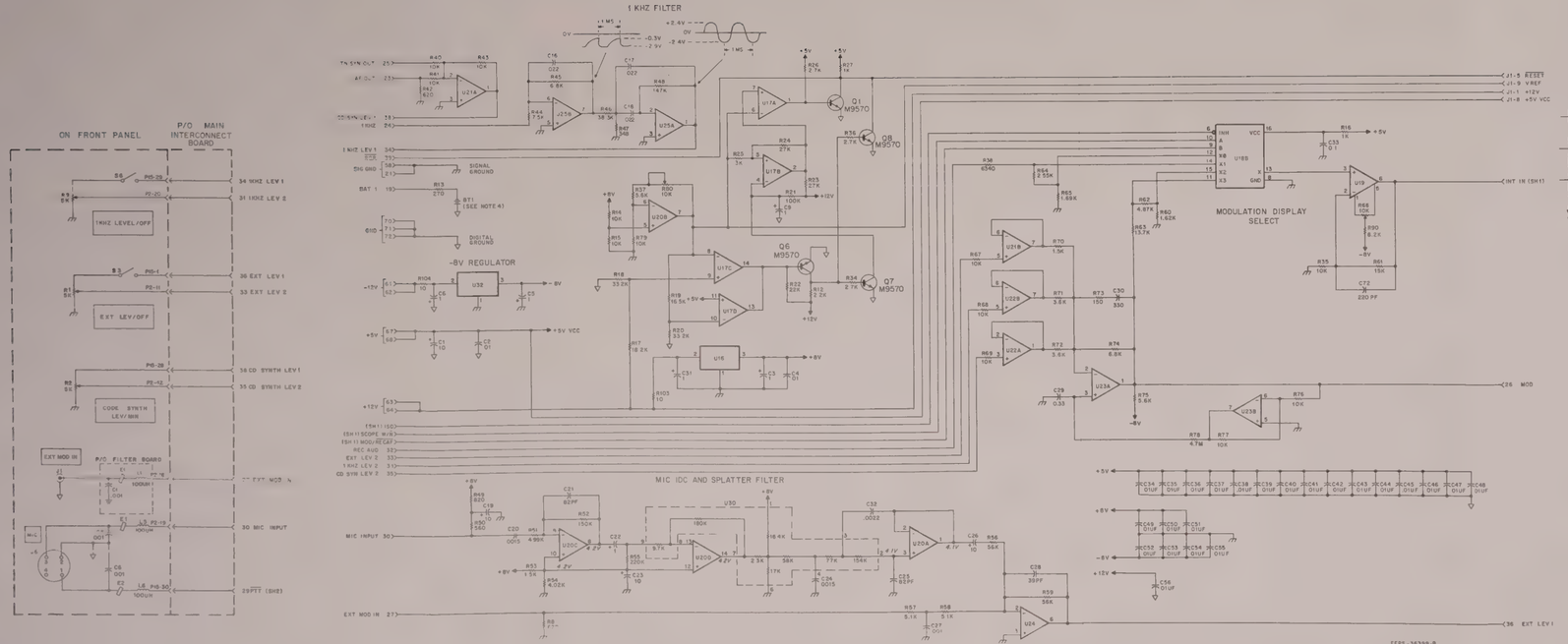


Motorola No. PEPS-36857-A
(Sheet 2 of 3)
4/1/84- PHI

FRONT PANEL INTERFACE BOARD

MODEL RTL4100A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



NOTES:

1. Unless otherwise indicated, all resistor values are in ohms, all capacitor values are in microfarads, and all inductors are in millihenries.
2. IC types are TTL and CMOS devices.
3. Integrated circuit connections for this board are as follows:

Reference Designation	Mfgr's. Description	-12 V	+12 V	+8 V	+5 V	Dig Gnd	Sig Gnd	-8 V
U1, U2	Dual 1 of 4 Decoder				16	8		
U3, U4, U31	Hex Inverter				14	7		
U5, U6	Quad 2 to 1 Multiplexer				16	8		
U7	Quad NAND				14	7		
U8, U9	Hex D Flip Flop				16	8		
U10, U33	Quad Op Amp		4			11		
U11	Quad Latch				16	8		
U12	8 Bit Shift Register				16	8		
U13	Dual D Flip Flop				14	7		
U14	Triple NOR				14	7		
U15	Decade Counter				16	8		
U16	Voltage Regulator		1	3			2	
U17	Quad Comparator		3			12		
U18	Dual 1 of 4 Multiplexer						8	7
U19	Op Amp			7				4
U20	Quad Op Amp		4				11	
U21, U22	Dual Op Amp			8				4
U23, U25	Dual Op Amp			8				4
U24, U26	Op Amp			7				4
U32	Voltage Regulator	2						1

4. Read the following WARNING and CAUTION regarding lithium batteries.

WARNING
Lithium Battery

The processor module within this system utilizes a lithium battery as a memory keep-alive voltage source. Do not mutilate or disassemble the battery cell. The lithium metal is a very active material that burns in the presence of water or high humidity. Do not put the battery in fire, attempt to charge, or heat above 100°C. Do not overdischarge the cell to a reverse voltage greater than 3 volts. The battery may burst and burn or release hazardous materials.

CAUTION
Lithium Battery

Lithium batteries are classified as hazardous materials and must be disposed of accordingly. Do not dispose of the battery by placing it in with the everyday trash. Consult state and local codes for the appropriate disposal procedure. Motorola will dispose of the battery if the expended battery is returned in the replacement battery container and by the same method that the new battery came to you. Send to: Motorola Inc. Return Goods Department, 1313 East Algonquin Road, Schaumburg, IL 60196

Motorola No. PEPS-36857-A
(Sheet 3 of 3)
4/1/84- PHI

FRONT PANEL INTERFACE BOARD

MOTOROLA INC.
Communications
Sector

FRONT PANEL DISPLAY BOARD

MODEL RTL4101A

1. DESCRIPTION

1.1 The front panel display board contains two liquid crystal displays (LCD) that present service data in both alphanumeric and graphic form. The front panel display board is a plug-in unit with power and data line connections to the front panel interface board.

1.2 The front panel display consists of two LCD's, 1-of-10 decoder, level shifters, display drivers, and a temperature compensating voltage regulator.

2. THEORY OF OPERATION

2.1 LIQUID CRYSTAL DISPLAY (LCD)

Each LCD is a segmented display with each of the 125 segments being multiplexed by voltage level drivers. The 125 segments are organized in a 32 × 4 matrix.

2.2 DISPLAY DRIVERS

The LCD multiplexing drive signals originate in drivers U1 and U2. Four backplane and 32 front plane drive signals are applied to the LCD module. The four different voltage levels required by the LCD are derived from the R1, R2, and R3 voltage divider.

2.3 ONE-OF-TEN DECODER

Front panels LED's are driven by the 1-of-10 decoder from inputs on the MØ-M3 data lines. The decoded signals cause U6 to output a low level on one of the ten output lines to light the appropriate LED.

2.4 SERIAL INTERFACE

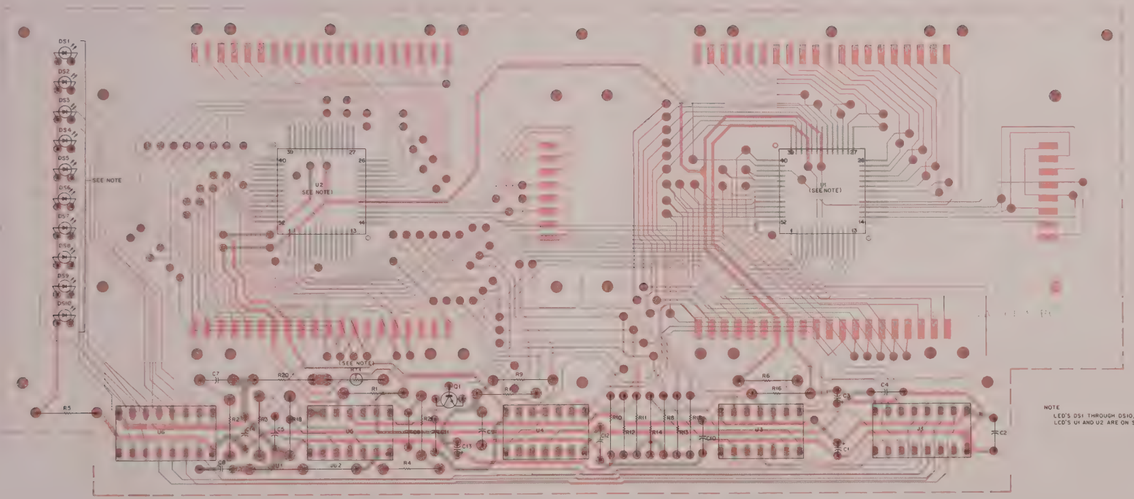
Display drivers U1 and U2 communicate with the front panel interface module via an 8-bit interface. Signals to level shifters U3 and U4 include a free running 170 kHz clock (LCD CK), a serial data stream ($\overline{SI}$), a control or data line ($\overline{C}$/D), a low level reset ($\overline{RESET}$), driver select CSA or CSB, serial data clock (SCK), and an output signal, $\overline{BSY}$.

2.5 TEMPERATURE COMPENSATION

To maintain a stable presentation on the LCD, the reference voltage and U1 and U2 supply voltages are temperature compensated by regulator U5. Transistor Q1 provides current gain.

FRONT PANEL DISPLAY BOARD

MODEL RTL4101A
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST



J1 DETAIL

+12 V	1	16	GND
M 3	2	15	M 1
M 2	3	14	M B
S 1	4	13	CBS
RESET	5	12	E/D
CS A	6	11	E B Y
SCK	7	10	LCD CK
+5 V	8	9	V R S F

NOTE
LED'S DS1 THROUGH DS10, THERMISTOR RT1, AND
LCD'S U1 AND U2 ARE ON SOLDER SIDE

COMPONENT SIDE = 80-PEPS-36394-D
SOLDER SIDE = 80-PEPS-36393-D
OL PEPS-36392-A

parts list

RTL4101A Front Pane Display Board — Pc 6456-0

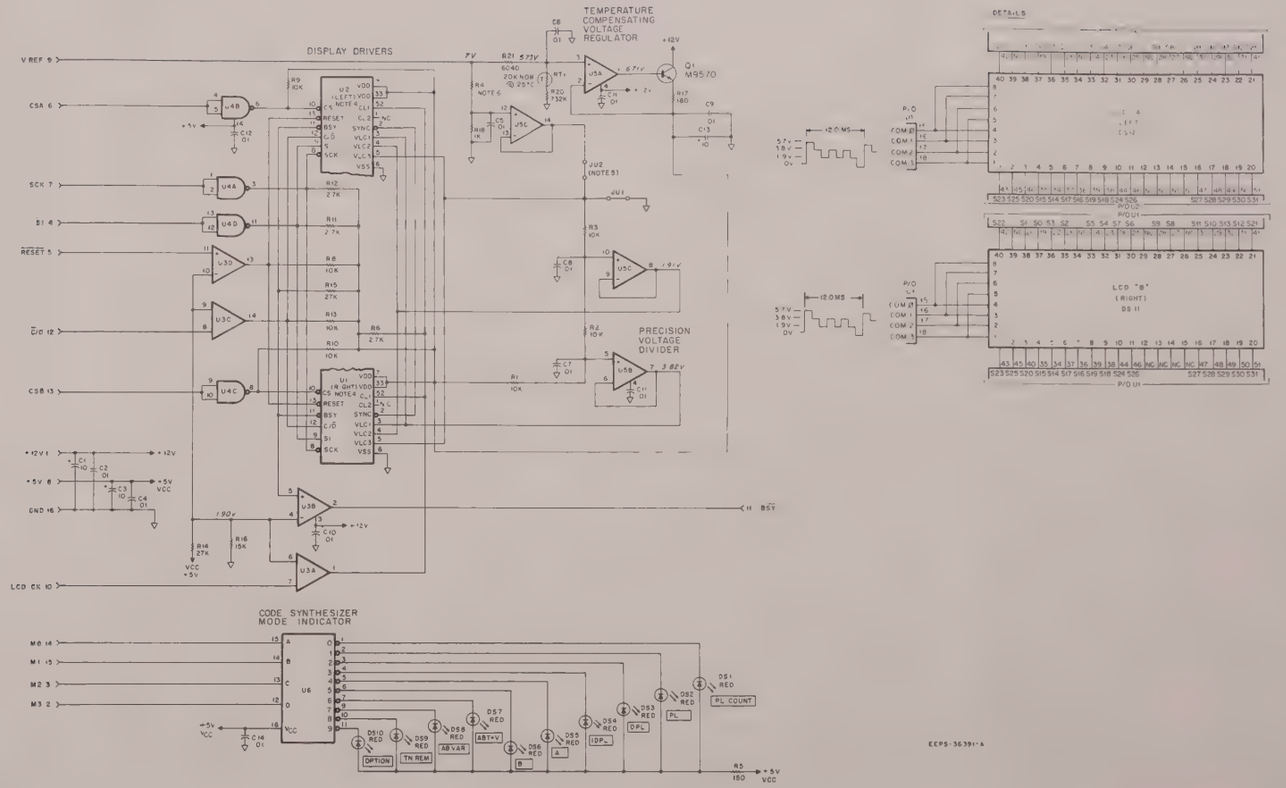
REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
		capacitor, fixed: uF ± 10-30%; 100 V unless otherwise stated
C1	23-84665F01	10 + 100-10%; 25 V
C2	21-82428B21	.01
C3	23-84665F01	10 + 100-10%; 25 V
C4	21-82428B21	.01
C5		NOT USED
C6 thru 12	21-82428B21	.01
C13	23-84665F01	10 + 100-10%; 25 V
C14	21-82428B21	.01
		light emitting diode: (see note)
DS1 thru 10	48-84404E03	red
DS11, 12	72-80377A01	display, custom
		transistor (see note)
Q1	48-869570	NPN: type MS570
		resistor, fixed, ± 5%; 1/4 W: unless otherwise stated
R1, 2, 3	6-83175C03	10k ± 1%; 1/8 W
R4		NOT USED
R5	6-11009C29	150
R6	6-11009C59	2.7k
R7		NOT USED
R8, 9, 10	6-11009C73	10k
R11, 12	6-11009C59	2.7k
R13	6-11009C73	10k
R14, 15	6-11009C83	27k
R16	6-11009C77	15k
R17	6-11009C31	180
R18	6-11009C49	1k
R19		NOT USED
R20	6-10621C78	7.32k ± 1%; 1/8 W
R21	6-10621C70	6.04k ± 1%; 1/8 W
		thermistor:
RT1	6-80378A45	20k @ 25°C
		integrated circuit: (see note)
U1, 2	51-80378A98	display driver
U3	51-84371K74	quad open collector NAND gate
U4	51-83627M04	quad comparator
U5	51-83829M08	quad operational amplifier
U6	51-80365A18	decoder driver
		mechanical parts
	3-124671	SCREW, tapping, 4-24 x 1/4", 16 used
	13-80377A39	BEZEL, LCD, 2 used
	31-80377A47	STRIP, Zebra, 4 used
	31-80377A48	STRIP, stepped Zebra, 2 used
	32-80390A78	GASKET, bezel, 2 used
	43-80378A93	BLOCK, mounting
	84-80377A89	CIRCUIT BOARD
	9-80330A49	SOCKET, 16-pin

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

FRONT PANEL DISPLAY BOARD

MODEL RTL4101A

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST



NOTES

1. Unless otherwise indicated, resistor values are in ohms, capacitor values are in microfarads, and inductor values are in millihenries.
2. IC types are TTL and CMOS devices.
3. Connections for integrated circuits on this board are as follows:

Reference Designation	Mfgr's Description	+12 V	VCC	Gnd
U1	Display Driver			6
U2	Display Driver			6
U3	Quad Comparator	3		12
U4	Quad Open Collector NAND		14	7
U5	Quad Op Amp	4		11
U6	1 of 10 Decoder		16	8

4. The LCD display interconnect wiring is shown in the detailed section on this drawing.
5. JU2 is not presently used. It is shown on the drawing for information only.
6. C5 and R4 are shown for information only. They are not used.

Motorola No. PEPS-36858-A
(Sheet 2 of 2)
4/1/84- PHI

FRONT PANEL DISPLAY BOARD

BATTERY PACK
MODEL RTP4021A

1. BATTERY PACK INSTALLATION

The following instructions detail the correct procedure for battery pack (RTP4021A) installation. See Figure 1.

Step 1. Remove and discard 4 nuts holding the battery retaining bars to the battery case. Remove the retaining bars and batteries from the case.

Step 2. Extract the Red and Black battery leads from the battery compartment.

Step 3. Place the battery case in the battery compartment. Screw in the center screws and attach the retaining bars with the 4 screws removed in Step 1. The battery case should now be attached with 6 screws.

Step 4. Connect the Red lead to the + terminal, the Black lead to the − terminal on one end and jumper from + to − on the other end of the batteries which places the batteries in series.

NOTE

EXT DC/BATTERY switch must be in the BATTERY position for battery operation.

2. BATTERY CHARGING

The following instructions detail the correct procedure for battery charging.

NOTE

Prolonged discharge of the battery can cause permanent damage to the battery. By law, new batteries must be shipped discharged.

Step 1. Connect the service monitor to an ac power source and select BATTERY on the rear panel. Turn the service monitor to ON. The service monitor charges in either the BATTERY **or** EXT DC positions.

Step 2. Read the battery voltage by selecting BATT on the right LCD. A fully charged battery reads 13.7 volts. A newly installed battery will charge overnight. Overnight charging of the battery can be accomplished by leaving the service monitor in ON or STANDBY.

NOTE

If ac power is connected to the service monitor, ac power is used automatically rather than dc power.

parts list

RTP4021A Battery Pack — PL-8642-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		mechanical parts
	1-80350A37	CABLE & CONNECTOR
	2-7019	NUT: 4-40 × 4 × 3/32", hex steel; 6 used
	3-138804	SCREW, machine; 4-40 × 5/16" Phillips; hex
	4-80395A88	WASHER, nylon; 4 used
	7-80377A37	BRACKET; mounting
	32-80390A79	GASKET; mounting; 4 used
	42-80377A38	CLAMP; 2 used
	60-80395A50	BATTERY; 6 V, 8 AH; 2 used

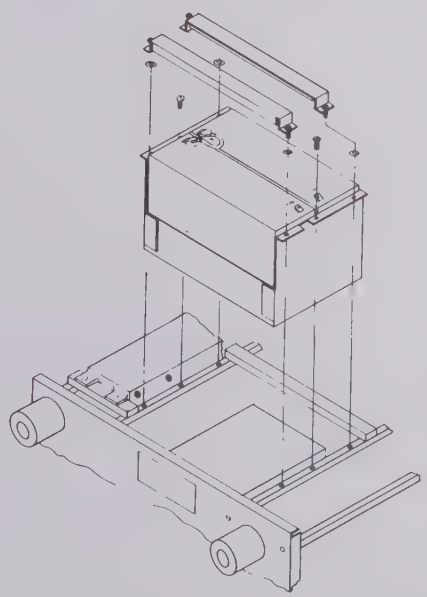


Figure 1. Battery Installation

parts list

RTX1008B Basic Chassis — PL-6500-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		motor:
B1	59-80378A94	fan
		capacitor, fixed:
C1 thru 7	21-83596E13	.001 uF ± 10%; 500 V
		light emitting diode: (see note)
DS1	48-05776C01	red
		coil:
E1 thru 7	76-83960B01	ferrite, core
E8	76-80397A74	ferrite bead
E9, 10, 11	76-80312A75	ferrite bead
		fuse.
F1	65-42092	2 amp; 250 V
F2	65-80397A22	8 amp; 32 V
F3	65-20404	3 amp; 250 V
F4	65-474899	1/8 amp; 250 V
		filter:
FL1	91-80390A52	line
		connector, receptacle:
J1 thru 5	9-855268	female; single contact (BNC)
J6	9-830418	female; 4-contact
J8	15-10811A07	housing, plug; 4-contact
J7	9-80378A51	female; single contact (BNC)
		coil, rf:
L1 thru 7	24-82549D41	choke; 100 mH
		connector, plug:
P1	15-80312B03	housing, 30-contact; 2 used
P2	15-80390A10	housing, 9-contact
P3	28-80390A05	male; 3-contact A.C.
		resistor:
R1	18-80378A30	variable: 5k; Includes S3
R2	18-80378A29	variable; 5k
R3, 4	18-80378A21	variable; 100k
R5		part of S4
R6, 7	18-80378A22	variable; 2k
R8		part of S5
R9	18-80378A30	variable: 5k; Includes S6
R10		part of S9
		varistor:
R11	6-80395A72	1200 amp, 430 V @25 °C
		switch:
S1	40-80378A10	spst, toggle
S2	40-80378A27	rotary; 5 position
S3		part of R1
S4	40-80312B41	1 pole; 4 position
S5	40-80378A27	rotary; 1 pole; 5 position
S6		part of R9
S7, 8	40-80378A34	spdt
S9	40-80397A30	1 pole; 3 position
S10	40-80397A33	rotary; 1 pole; 3 position
S11	40-80378A35	single pole triple throw
S12	40-80395A84	dpdt
S13	40–80390A50	rocker
		transformer:
T3	25-80312B80	line

ref. no.		mechanical parts
1	38-80337A83	KNOB; 8 used
2	38-80397A63	KNOB
3	38-80337A88	KNOB; 4 used
4	38-80337A89	KNOB (BLK and BLU)
5	38-80337A85	KNOB (BLK); 2 used
	2-115123	NUT, 10-32 × 3/8 × 1/8"; 2 used
	2-131435	NUT, 4-40 × 1/4 × 3/32"; 3 used
	3-136782	SCREW, machine: 2-56 × 3/16"; 2 used
	3-138804	SCREW, machine: 4-40 × 5/16"; 36 used
	3-138929	SCREW, machine: 4-40 × 5/8" 14 used
	3-139579	SCREW, machine: 4-40 × 5/16" 14 used
	3-140207	SCREW, machine: 4-40 × 5/16"; 8 used
	3-80335A97	SCREW, machine: BLK; 8-32 × 0.312"; 7 used
	43-80312B10	SPACER BEAM; 2 used
	43-80397A41	STANDOFF: hex 1/4"; 8 used
	4-8406	LOCKWASHER, #2 internal; 2 used
	4-140208	LOCKWAHER, #4 split; 8 used
	4-140209	LOCKWASHER, #6 split; 7 used
	7-80390A17	BRACKET, card guide; 2 used
	2-84201D82	NUT, 2 used
	3-139013	SCREW, machine; 4-40 × 3/16; Phillips; 8 used
	4-8434	LOCKWASHER; #4 int.; 4 used
	26-80312B13	SHIELD; 4 used
	26-80397A70	SHIELD
	26-80397A78	SHIELD

REFERENCE SYMBOL	MOTOROLA PART NO	DESCRIPTION
	26-80397A67	SHIELD
	26-80397A69	SHIELD
	42-80313A70	STRAP, tie: 4" long
	46-80377A49	GUIDE, card, 2 used
	46-80395A24	GUIDE, card (ORG); 2 used
	46 80395A25	GUIDE, card (YEL); 2 used
	46 80395A26	GUIDE, card (BLU); 2 used
	46-80395A27	GUIDE, card (RED); 2 used
	46-80395A28	GUIDE, card (BRN) 2 used
	46-80395A29	GUIDE, card (GRN); 2 used
	46 80395A30	GUIDE, card (VIO); 2 used
	47-80377A11	BEAM, main
	47-80377A12	BEAM, main
	47-80377A13	BEAM, main
	47-80377A14	BEAM, main
	47-80377A15	BEAM, main
	47-80377A16	BEAM, main
	47-80377A17	BEAM, cross
	47-80377A18	BEAM, cross
	47-80377A19	BEAM, cross
	47-80377A20	BEAM, center
	47-80377A21	BEAM, support
	47-80378A63	BEAM, center
	54-80317B08	LABEL, identification
	55-80378A53	HANDLE
	15-80377A34	HOUSING, power supply
	46-80377A40	GUIDE, card; 2 used
	64-80312B73	PLATE, base
	1-80351A49	ASSEMBLY FRONT PANEL includes refer J1 thru 8, R1, 2, 3, 4, 9, L1, 2, 3, S1, 2, 4, 9, 10, 11, 12, P1
	1-80350A50	ASSEMBLY CABLE w/CONNECTOR includes P1
	30-848407	CABLE, 2 conductor shielded, 10" used
	30-859004	CABLE, coaxial RG188/U
	39-80312B11	CONTACT, crimp; 54 used
	1-80350A39	ASSEMBLY FILTER BOARD includes refer C4, 5, 6, 7 and L4, 5, 6, 7, & E4, 5, 6, 7
	4-7699	LOCKWASHER #13/16" internal
	4-115021	LOCKWASHER #1/4" internal, 6 used
	4-125904	LOCKWASHER 0.375 × 0.625 × .030; 7 used
	4-80395A94	WASHER, dress; 3 used
	4-80397A42	WASHER, retainer
	7-80378A50	BRACKET, LED mounting
	13-80390A41	BEZEL, 2 used
	13-80390A42	BEZEL
	14-80312B01	INSULATOR, shield; 1/2 × 3/4
	26-80397A60	SHIELD, connector
	26-80397A65	SHIELD
	29-10261A05	LUG, soldering; 3 used
	30-83794C01	CABLE, coaxial; 6" used
	35-80390A46	SCREEN, scope w/graticule
	64-80312B59	PANEL, front
	64-80377A51	PANEL, front
	1-80351A41	ASSEMBLY REAR PANEL includes: B1, F1, F2, E8, E9, FL1, P1 P3, R11, and J6
	2-115123	NUT, 10-32 × 3/8 × 1/8"; 4 used
	2-131435	NUT, 4-40 × 1/4 × 3/32"; 10 used
	2-132616	NUT, 6-32 × 1/4 × 3/32 × 1/8"; 3 used
	3-138810	SCREW, machine: 4-40 × 5/8"
	3-490642	SCREW, machine: 10-32 × 1-1/2"; 4 used
	3-80312B02	SCREW, machine. 4-40 × 1-1/8"; 4 used
	3-80335A97	SCREW (BLK) 6-32 × 0.312; 3 used
	3-80395A09	SCREW, Phillips pan: 4-40 × 0.375; 14 used
	4-7607	WASHER, flat. 0.125 × 0 281 × .027
	4-140208	LOCKWASHER, #4 split; 18 used
	4-140209	LOCKWASHER, #6 split; 3 used
	9-80312B40	RECEPTACLE, fuse, 3 used
	9-82393K02	CONNECTOR
	13-80390A35	GRILLE
	14-80312B64	INSULATOR
	26-80312B63	SHIELD
	29-5248	LUG, soldering; 2 used
	39-80397A64	CONTACT, receptacle; 2 used
	30-80395A86	CABLE, 9 conductor
	38-80395A08	CAP, sealing connector
	43-80312B58	SPACER, BLK; 3 used
	39-10184A24	CONTACT, receptacle; 2 used
	39-10184A91	CONTACT, receptacle, 3 used
	39-80395A83	TERMINAL, socket; 8 used
	39 80397A64	CONTACT, 2 used
	42-82143C01	CLAMP, cable
	43-80390A34	SPACER; 4 used
	64-80312B65	PANEL, back
	75-80378A91	FEET, rubber, 4 used
	54-80317B90	LABEL, identification
	1-80307A71	IC ASSEMBLY, interconnect
	15-80390A10	HOUSING, connector; 9-position
	29-80312B22	CONTACT; 2 used

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers

RTL4125B Hardware Kit — PL-8979-O

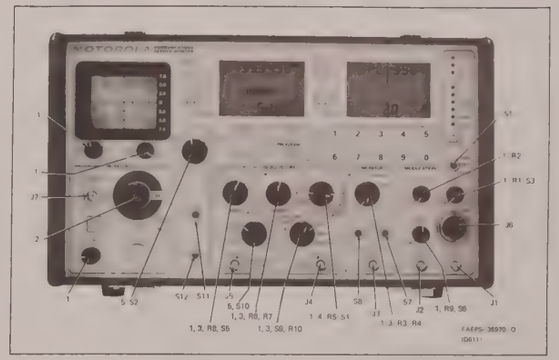
REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		battery:
BT1	60-83294N03	3 V; lithium
		non-referenced items
	3-138804	SCREW, machine: 4-40 × 5/16"; 13 used
	3-139581	SCREW, machine: 4-40 × 5/16"; 2 used
	3-140207	SCREW, machine: 4-40 × 5/16"; 21 used
	3-80335A97	SCREW, black, 6-32 × 0.312"; 3 used
	4-1714	WASHER, flat; 0 250 × 0 562 × .054
	4-7607	WASHER, flat; 0.125 × 0.281 × .027; 2 used
	4-135739	WASHER, flat, 0 128 × 0 800 × .021
	4-140208	WASHER, lock #4 split; 21 used
	4-140209	WASHER, lock #6 split; 3 used
	4-80395A88	WASHER, nylon; 2 used
	2-8364	NUT, hex: 3/8-32 × 1/2 × 3/32"; 2 used
	2-80325A82	NUT, spring; 4 used
	3-120821	SCREW, machine: 4-40 × 1/4"; 8 used
	3-136886	SCREW, machine: 4-40 × 3/8"; 10 used
	3-80342A47	SCREW, machine: 6-32 × 1/4"; 4 used
	4-8434	WASHER, lock #4 internal; 8 used
	7-80390A16	BRACKET, clip
	15-80312B69	COVER, top
	26-80312B04	SHIELD
	26-80312B05	SHIELD
	26-80312B06	SHIELD; 2 used
	33-80348A05	NAMEPLATE
	30-80397A62	CORD, line AC
	32-80390A18	GASKET
	35-80337A83	KNOB, 3 used
	36-80397A63	KNOB
	41-80312B15	SPRING, compression
	41-80397A47	SPRING; 2 used
	41-80312B16	SPRING
	42-80313A70	TIE WRAP 4"
	54-80397A77	LABEL
	54-83581L01	LABEL, line cord
	55-80390A29	STRIKE; 2 used
	55-80395A05	HINGE; 2 used
	64-80377A28	BEZEL, casting

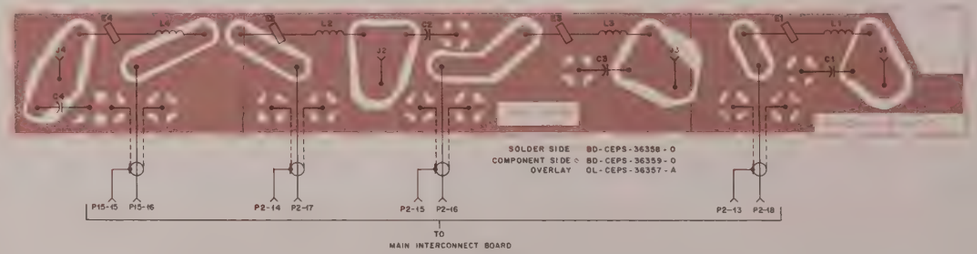
R2200B Service Monitor Miscellaneous Parts — PL-8980-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector
J1	28-82365D02	male, single contact (phono)
		mechanical parts
	1-80356A05	CABLE, coaxial, flex
	1-80356A07	CABLE, semi-rigid
	1-80356A09	CABLE, semi-rigid
	1-80307A73	ASSEMBLY IC, Interconnect; 2.5" includes J1
	30-83794C01	CABLE, coaxial; 20"
	1-80351A48	ASSEMBLY BOTTOM COVER, includes:
	4-114970	WASHER, flat, 0.125 × 0.250 × .020; 6 used
	4-7569	WASHER, flat
	14-80397A43	INSULATOR
	15-80312B70	COVER, bottom
	55-80334A52	BAIL, self-lock
	75-82566B01	BUMPER, rubber; 2 used
	1-80350A30	ASSEMBLY CABLE & CONNECTOR, includes J1
	1-80356A08	ASSEMBLY CABLE, coaxial
	1-80350A31	ASSEMBLY CABLE & CONNECTOR, includes: J1
	30-859004	CABLE, coaxial RG 188U; 18" used

RPX4249B Fuse Replacement Kit — PL-8981-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		fuse
F2	65-80397A22	8 amp; 32 V
F3	65-20404	3 amp, 250 V
F4	65-474899	1/8 amp; 250 V (110 V operation)
	or 65-80377A81	0.1 amp; 250 V (220 V operation)





SHOWN FROM COMPONENT SIDE

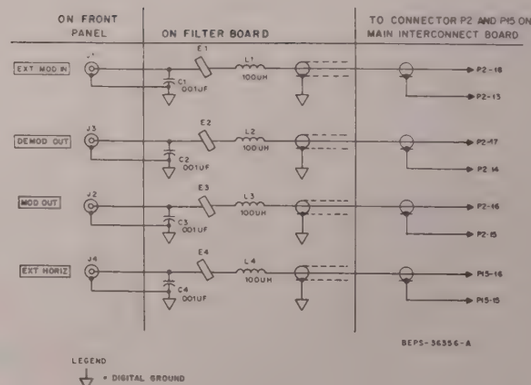
CHASSIS MECHANICAL LESS REAR PANEL AND MAIN INTERCONNECT BOARD

MODEL RTX1008B

SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

FUNCTION

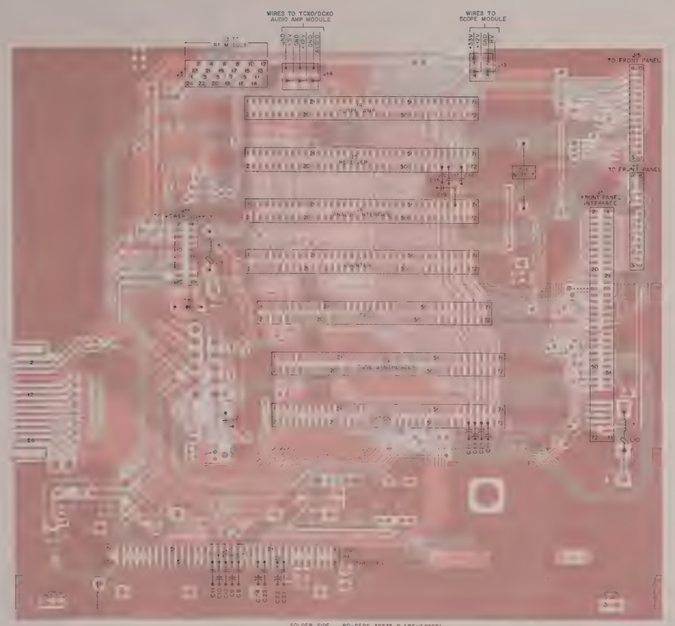
The Chassis Mechanical section includes parts lists for the mechanical and electrical parts that mount on the chassis. Also included is a filter board that mounts to the chassis. The chassis main interconnect board is covered in a separate instruction section, 68P81064E69, in this manual.



CHASSIS MECHANICAL

MAIN INTERCONNECT BOARD

MODEL RTL4099B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL,
AND PARTS LIST

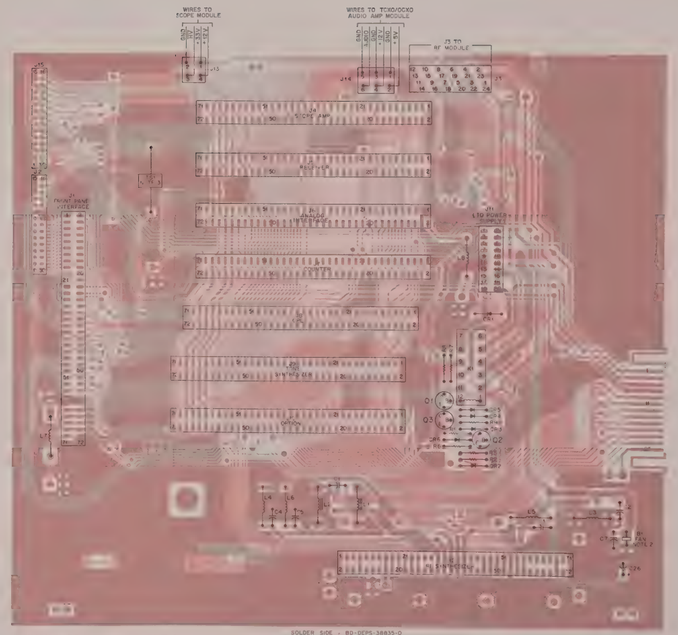


SHOWN FROM SOLDER SIDE

SOLDER SIDE = 80-DEPS-38835-O (REVERSED)
COMPONENT SIDE = 80-DEPS-38834-O (REVERSED)
OL-EEPS-38836-O

NOTES:

1. CONNECTOR DETAILS ARE SHOWN ON INTERCONNECT BOARD SCHEMATIC DIAGRAM.
2. CAPACITORS ARE CHIP COMPONENTS.
3. TS1 IS A THERMAL SWITCH.



SHOWN FROM COMPONENT SIDE

SOLDER SIDE = 80-DEPS-38835-O
COMPONENT SIDE = 80-DEPS-38834-O
OL-EEPS-38833-O

NOTES:

1. CONNECTOR DETAILS ARE SHOWN ON INTERCONNECT BOARD SCHEMATIC DIAGRAM.
2. FAN B1 IS MOUNTED ON REAR PANEL.
3. TS1 IS A THERMAL SWITCH.

TRANSISTOR DETAILS

parts list

RTL4099B Main Interconnect Board — PL-8472-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1 thru 4	21-82372C07	.05 + 80-20%, 25 V
C5	21-82428B21	.01 uF + 10-30%, 100 V
C6	23-84665F14	220 uF + 150-10%, 16 V
C7	21-82428B21	.01 uF + 10-30%, 100 V
C8 thru 19	21-80376A35	.001 uF ± 10%, 50 V (chip)
C20	21-80376A29	.015 uF (chip)
C21, 22, 23, 24	21-80376A14	220 pF ± 2%, 50 V (chip)
C25	21-80376A35	.001 uF ± 10%, 50 V (chip)
C26	23-84665F02	15 uF + 100-10%, 25 V
		diode: (see note)
CR1	48-83654H02	silicon
CR2	48-83654H01	silicon
CR3	48-83654H02	silicon
CR4, 5	48-82466H01	silicon
		connector, receptacle:
J1	9-80377A45	female, 72-contact (edge connector)
J2	9-80312B77	female, 30-contact
J3	30-80312B38	cable, 24-conductor; includes P302
J4 thru 10	9-80377A45	female; 72-contact (edge connector)
J11	1-80350A24	cable, 20 conductor includes P3
J12	9-80377A45	female; 72-contact (edge connector)
J13	1-80350A22	cable, 4 conductor includes P2
J14	1-80350A23	cable, 6 conductor includes P14
J15	9-80312B77	female; 30-contact
		relay:
K1	80-80378A31	4 pole, single throw; 720 ohms
		coil, rf:
L1, 2, 3	25-83127G01	choke; 1 mH
L4, 5, 6	24-82548D41	choke; 100 uH
L7, 8	24-83451F01	inductor/bead
L9, 10	9-84196B01	ferrite bead
		transistor: (see note)
Q1	48-866570	NPN, type MRF570
Q2	48-869648	NPN; type MJ648
Q3	48-869706	Darlington, MRF706
		resistor: fixed: ± 5%, 1/4 W unless otherwise stated.
R1		NOT USED
R2	6-124A01	10
R3	6-124A73	10k
R5, 6	6-124A89	47k
R7	6-124A73	10k
R8	6-124A85	47k
R9	6-124A89	47k
R10 thru 18	6-110548[illegible]	1k, 1/8 W, chip
R19, 20	6-110424A13	10k, 1/8 W, chip
		switch:
TS1	80-80387A26	spst; temperature dependent
		voltage regulator: (see note)
VR1	48-82256C15	Zener type, 5.1 V
		mechanical parts
	42-80313A70	TIE WRAP, 4", 5 used
	30-83794C01	CABLE, coaxial; WHT

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

68P81064E69-A
(Sheet 1 of 2)
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CONNECTOR DETAILS

PIN NUMBER	J9 A12 TONE SYNTHESIZER	J10 A08 OPTION	J6 A06 CPU
1	GND	GND	GND
2	GND	GND	LC BUSY
3	—	—	340 kHz
4	OPT. PRES.	OPT. PRES. PL COUNT FILTER	OPT. PRES.
5	—	—	—
6	—	—	AD. INT.
7	—	—	—
8	—	COUNT INT.	COUNT INT.
9	REC. AUD.	REC. AUD. MOD OUT	REC. AUD. MOD OUT
10	—	—	—
11	—	AGC	—
12	—	—	—
13	—	—	—
14	—	—	—
15	—	—	—
16	—	—	—
17	—	—	—
18	—	—	—
19	—	BAT 1	BAT 1
20	—	—	—
21	GND	GND	GND
22	AF OUT	AF OUT	AF OUT
23	GND	GND	GND
24	1 kHz TN SYNTH OUT	1 kHz TN SYNTH OUT	1 kHz TN SYNTH OUT
25	—	—	—
26	MOD	MOD	MOD
27	SQ OPN	SQ OPN	SQ OPN
28	NOPINT	NOPINT	NOPINT
29	NTSRQ	NTSRQ	NTSRQ
30	PCTL	PCTL	PCTL
31	I/O 7	I/O 7	I/O 7
32	PFLG	PFLG	PFLG
33	I/O 5	I/O 5	I/O 5
34	I/O 6	I/O 6	I/O 6
35	I/O 3	I/O 3	I/O 3
36	I/O 4	I/O 4	I/O 4
37	I/O 1	I/O 1	I/O 1
38	I/O 2	I/O 2	I/O 2
39	P.O.R	P.O.R	P.O.R
40	I/O 0	I/O 0	I/O 0
41	D8	D8	D8
42	D7	D7	D7
43	D4	D4	D4
44	D5	D5	D5
45	D2	D2	D2
46	D3	D3	D3
47	D0	D0	D0
48	D1	D1	D1
49	STB2	STB2	STB2
50	STB3	STB3	STB3
51	STB0	STB0	STB0
52	STB1	STB1	STB1
53	A2	A2	A2
54	A3	A3	A3
55	A0	A0	A0
56	A1	A1	A1
57	DPL	DPL	DPL
58	GND	GND	GND
59	—	—	—
60	—	1 KHz CONT	—
61	- 12 V	- 12 V	- 12 V
62	- 12 V	- 12 V	- 12 V
63	+ 12 V	+ 12 V	+ 12 V
64	+ 12 V	+ 12 V	+ 12 V
65	- 5 V	- 5 V	- 5 V
66	- 5 V	- 5 V	- 5 V
67	+ 5 V	+ 5 V	+ 5 V
68	+ 5 V	+ 5 V	+ 5 V
69	—	EXT. CONT	—
70	IRQ	IRQ	IRQ
71	GND	GND	GND
72	GND	GND	GND

PIN NUMBER	J7 A10 COUNTER	J8 A07 ANALOG INTERFACE	J5 A08 RECEIVER	J4 A04 SCOPE AMPLIFIER
1	GND	GND	GND	GND
2	AUDIO	EXT. VERT. IN	—	GND
3	—	GND	SQ. IND.	SQ. IND.
4	10.7 MHz	GND	10.7 MHz	—
5	—	—	—	HOR. VERN. 2
6	AD INT	—	—	—
7	—	—	—	AD. INT.
8	COUNT INT.	—	—	—
9	REC. AUD. MOD OUT	REC. AUD. MOD OUT	REC. AUD MOD OUT	EXT. HOR. IN** REC. AUD. MOD OUT
10	—	—	—	—
11	D.C. REF & AUD IN (AM)	D.C. REF & AUD IN (AM)	D.C. REF & AUD IN (AM)	—
12	DEMOD OUT	DEMOD OUT	DEMOD OUT	DEMOD OUT
13	BTRY. SENS.	BTRY. SENS.	—	—
14	A/D INPUT	A/D	—	—
15	PCT AM	PCT AM	PCT AM	—
16	—	AGC	AGC	—
17	—	—	SQ. POT 1	SQ. POT 1
18	—	—	SQ. POT 2	SQ. POT 2
19	VOL. 1	VOL. 1	VOL. 1	VOL. 1
20	VOL. 2	VOL. 2	VOL. 2	VOL. 2
21	CAR. & MOD LEVEL OUT	CAR. & MOD LEVEL OUT POWER METER	POWER METER	—
22	—	—	—	HV
23	—	—	—	—
24	1 kHz	—	—	—
25	—	—	—	—
26	MOD	—	—	—
27	—	—	—	—
28	—	—	—	VERT. VERN. 1
29	—	—	—	VERT. VERN. 2
30	—	—	—	TRIG LVL 2 TRIG LVL 3
31	—	—	—	HOR. POS. 3
32	—	—	—	TRIG LVL 1
33	—	—	—	HOR. POS. 1
34	—	—	—	HOR. POS. 2
35	—	—	—	VERT. POS. 2
36	—	—	—	—
37	—	—	—	VERT. POS. 3
38	—	—	—	—
39	P.O.R.	P.O.R	P.O.R.	VERT. POS. 1 P.O.R.
40	—	—	—	—
41	D6	D6	D6	D6
42	D7	D7	D7	D7
43	D4	D4	D4	D4
44	D5	D5	D5	D5
45	D2	D2	D2	D2
46	D3	D3	D3	D3
47	D0	D0	D0	D0
48	D1	D1	D1	D1
49	STB2	STB2	STB2	STB2
50	STB3	STB3	STB3	STB3
51	STB0	STB0	STB0	STB0
52	STB1	STB1	STB1	STB1
53	A2	A2	A2	A2
54	A3	A3	A3	A3
55	A0	A0	A0	A0
56	A1	A1	A1	A1
57	SIGN	SIGN	—	—
58	GND	GND	GND GND	GND
59	—	—	—	—
60	PK. DET	PK. DET	—	—
61	- 12 V	- 12 V	- 12 V	- 12V
62	- 12 V	- 12 V	- 12 V	- 12V
63	+ 12 V	+ 12 V	+ 12 V	+ 13V
64	+ 12 V	+ 12 V	+ 12 V	+ 12V
65	- 5 V	- 5 V	- 5 V	- 5V
66	AGDC SEL.	AGDC SEL.	—	—
67	+ 5 V	+ 5 V	+ 5 V	+ 5V
68	+ 5 V	+ 5 V	+ 5 V	+ 5V
69	10 MHz	—	—	—
70	IRQ	—	—	—
71	GND	GND	GND	GND
72	GND	GND	GND	GND

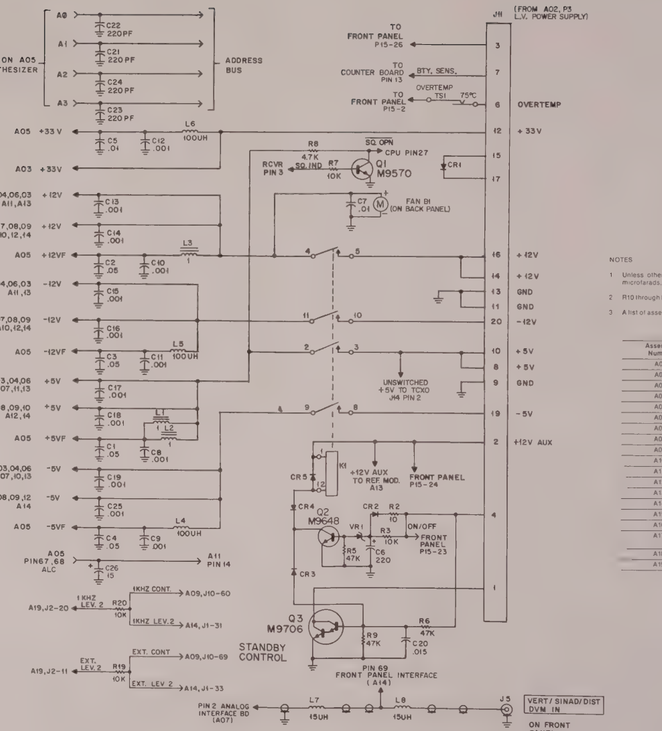
** From Filter Board on Front Panel

PIN NUMBER	J1 A14 FRONT PANEL INTERFACE	J3* A11 RF INTERFACE	J12 A05 RF SYNTHESIZER	J21* P/O A19 FRONT PANEL	J15* P/O A19 FRONT PANEL
1	GND	D7	GND	+ 12 V	EXT. LEV. 1
2	LC. BUSY	D0	GND	R0	ON/OFF PIN 1
3	C0	D1	—	R2	VOL. 2
4	340 kHz	D2	—	R4	SQ. 2
5	C3	D3	—	R6	SQ. IND
6	C1	D4	—	C0	TRIG. 3
7	C1	A1	1 kHz	C2	SQ. 1
8	C2	A0	1 kHz	C4	VERT. POS. 2
9	R7	STB1	—	—	HOR. POS. 1
10	C0	A2	—	GND	HOR. POS. 3
11	R5	A3	—	EXT. LEV. 2	TRIG. 2
12	R6	+ 5 V	—	CD SYN. LEV. 2	HOR. VERN. 2
13	R3	GND	—	GND	VERT. VERN. 1
14	R4	ALC	—	GND	GND
15	R1	LO/HI SEL.	10 MHz	GND	GND
16	R2	CAR & MOD LEVEL OUT	10 MHz	MOD OUT**	EXT. HOR. IN**
17	BW W/N	POWER METER	A1	DEMOD OUT**	SPKR
18	R0	D.C. REF & AUDIO	A1	EXT. MOD IN**	VERT. VERN. 2 IN (AM)
19	BAT 1	P.O.R.	A0	PTT	VERT. POS. 1
20		D6	A0	1 kHz LEV. 2	VERT. POS. 2
21	SIG. GND	D6	STB1	GND	HOR. POS. 2
22	AF OUT	D7	STB1	GND	TRIG 1
23	AF OUT	− 12 V	A3	C5	ON/OFF PIN 5
24	1 kHz	+ 12 V	A3	C3	ON/OFF PIN 4
25	TN. SYN. OUT	—	A2	C1	GND
26	MOD	—	A2	R7	ON/OFF PIN 3
27	EXT. MOD IN	—	—	R5	VOL. 1
28	—	—	—	R3	CD. SYN. LEV. 1
29	PTT	—	—	R1	1 kHz LEV. 1
30	MIC INPUT	—	—	BW W /IN COM.	MIC. IN
31	1 kHz LEV. 2	—	+ 5 VF	—	—
32	REC. AUD.	—	+ 5 VF	—	—
33	EXT. LEV. 2	—	− 5 VF	—	—
34	1 kHz LEV. 1	—	− 5 VF	—	—
35	CD. SYN. LEV. 2	—	+ 33 VF	—	—
36	EXT. LEV. 1	—	+ 33 VF	—	—
37	GND	—	+ 12 VF	—	—
38	CD. SYN. LEV. 1	—	+ 12 VF	—	—
39	P.O.R.	—	− 12 VF	—	—
40	GND	—	− 12 VF	—	—
41	D6	—	—	—	—
42	D7	—	—	—	—
43	D4	—	—	—	—
44	D5	—	—	—	—
45	D2	—	—	—	—
46	D3	—	D0	—	—
47	D0	—	D0	—	—
48	D1	—	D1	—	—
49	STB2	—	D1	—	—
50	STB3	—	D3	—	—
51	STB0	—	D3	—	—
52	STB1	—	D2	—	—
53	A2	—	D2	—	—
54	A3	—	GND	—	—
55	A0	—	GND	—	—
56	A1	—	MOD	—	—
57	GND	—	MOD	—	—
58	GND	—	LO/HI BAND	—	—
59	GND	—	LO/HI BAND	—	—
60	GND	—	—	—	—
61	− 12 V	—	—	—	—
62	− 12 V	—	—	—	—
63	+ 12 V	—	—	—	—
64	+ 12 V	—	—	—	—
65	− 5 V	—	—	—	—
66	− 5 V	—	—	—	—
67	+ 5 V	—	ALC	—	—
68	+ 5 V	—	ALC	—	—
69	EXT. VERT. IN	—	—	—	—
70	GND	—	—	—	—
71	GND	—	GND	—	—
72	GND	—	GND	—	—

*J2 and J15 have 30 pins; J3 has 24 pins

PIN NUMBER	J13 A03 SCOPE MODULE
1	+ 33 V
2	GND
3	HV
4	+ 12 V

PIN NUMBER	J14 A13 REF/AUDIO MODULE
1	GND
2	+ 5 V
3	GND
4	+ 12 AUX
5	GND
6	AUDIO



NOTES

1. Unless otherwise specified, all resistors are in ohms, all capacitors are in microfarads, and all inductors are in millihenries.
2. R10 through R18 are 15k pull up chip resistors to + 5 V.
3. A list of assemblies referenced is shown in Table 1.

Table 1. List of Assemblies

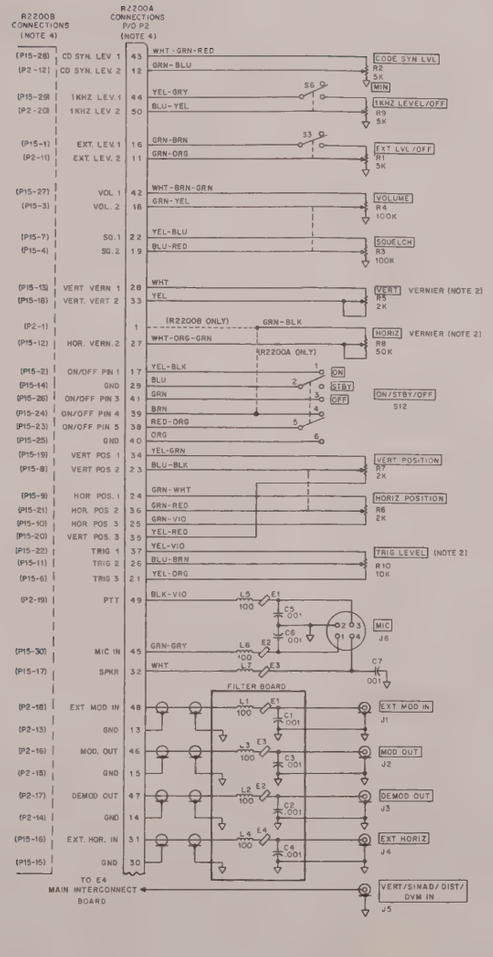
Assembly Number	Assembly/Subassembly Name
A01	Rear Panel
A02	Low Voltage Power Supply
A03	Scope Module
A04	Scope Amplifier Board
A05	RF Synthesizer Module
A06	Receiver Board
A07	Analog Interface Board
A08	CPU Board
A09	Option
A10	Counter Board
A11	RF Module
A12	Tone Synthesizer Board
A13	Reference/Audio Module
A14	Front Panel Interface Board
A15	Front Panel Display Board
A16	Battery Pack
A17	Chassis Mechanical Less Rear Panel and Main Interconnect Board
A18	Main Interconnect Board
A19	Front Panel

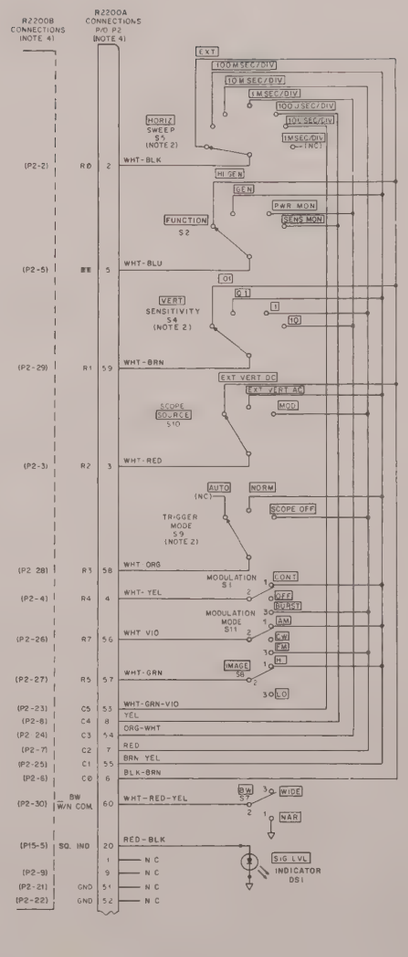
MAIN INTERCONNECT BOARD

MODEL RTL4099B
SCHEMATIC DIAGRAM, CIRCUIT BOARD DETAIL, AND PARTS LIST

FUNCTION

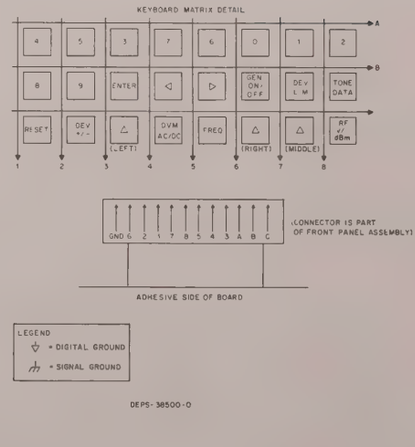
The main interconnect board provides a common interface for all of the modules and circuit boards. This includes the power supply lines, address and data lines, and any other lines which are needed for the boards to interconnect to one another. These same signals are routed from the board through wires or ribbon cables to other modules (modules that do not plug directly into the main interconnect board). The board also contains circuitry that delays the power supply when switching from the STBY to ON position, and filtering of the supply lines that go into the rf synthesizer. The front panel wiring harness plugs into this board.





NOTES

1. Unless otherwise specified, all resistor values are in ohms, all capacitor values are in microfarads, and all inductor values are in microhenries.
2. Potentiometers R5, R8, and R10 are ganged with switches S4, S5, and S9 respectively.
3. Pin numbers 1 through 30 are screened on connector P2. Pin 31 is opposite side of 30, 32 opposite side of 29, 33 opposite side of 28, etc.
4. R2200A Service Monitors use a single 60-pin connector (P2) as shown. R2200B Service Monitors use two 30-pin connectors (P2 and P15) as shown in parentheses.



FUNCTION

The front panel assembly consists of a front panel display board, a filter board, and the service monitor operating switches and controls. The front panel display board is described in instruction section 68P81064E66 in this manual. The filter board is shown as part of Chassis Mechanical instruction section 68P81064E68 in this manual. The front panel operating switches and controls are shown schematically on this page as well as in the respective instruction sections wherein the switches and controls interact. The front panel parts list is a part of the Basic Chassis Kit Model RTX1008B which appears in Chassis Mechanical instruction section 68P81064E68.

1. ACCESSORY KIT RPX4097A

1.1 Accessory Kit RPX4097A consists of a connector shell, clamp, and four connector pins. These parts can be used to fabricate a mating plug for the male dc power connector at the back of the service monitor. This enables a user to make a dc power cable to interconnect a separate power source to the service monitor.

1.2 Assemble the connector kit as follows:

Step 1. Connect pin 1 to + (11 to 17 V dc); pin 2 to NC; pin 3 to NC; and pin 4 to ground.

NOTE

Use wire large enough to carry 6 amps with no significant loss, i.e,
18 AWG for up to 6 feet;
20 AWG for up to 16 feet.
The terminals supplied are #18-#14 with inside diameter .110''-.150''.

Step 2. Select EXT DC on the rear panel.

Step 3. With no ac power applied to the service monitor, turn the service monitor to ON and measure the external dc voltage using the BATT measurement on the right LCD. This voltage must be between 11 and 17 volts dc for proper operation.

NOTE

If ac power is connected to the service monitor, ac power is used automatically rather than dc power.

parts list

RPX4097A Accessory Kit — PL-8479-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		connector, receptable:
P1	15-10811A08	housing, 4-contact
	9-83741F01	female; single-contact; 4 used
		mechanical part
	15-10812A01	SHELL, connector

2. TEST MICROPHONE RTM4000B

The test microphone contains the microphone element and a push-to-talk (PTT) switch. The microphone converts speech to transmit audio signals for the service monitor. The PTT switch turns the microphone on and off.

parts list

RTM4000B Test Microphone — PL-8477-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		capacitor, fixed:
C1	23-82601A34	2 uF + 100-10%; 25 V
C2, 3	21-84547A17	3300 pF ± 20%; 25 V
		cartridge:
DP1	50-83905L01	dynamic, impedance, 400 ohm; ± 20%; @ 1 kHz
		connector, receptacle:
J1	28-16370	male; 4-contact
		transistor: (see note)
Q1	48-869642	NPN; type M9642
		switch:
S1	40-84241G05	dpdt, slide
		integrated circuit: (see note)
U1	51-84333G79	preamplifier hybrid
		mechanical parts
	1-80796B52	ASSEMBLY, preamplifier; includes: C2, C3, Q1, U1
	3-139797	SCREW, tapping; 5-20 × 5/8''; 3 used
	15-83573L01	HOUSING, microphone front
	33-80348A01	NAMEPLATE
	33-83577L01	NAMEPLATE
	35-83575L01	GRILLECLOTH
	38-83574L01	PUSHBUTTON, microphone
	54-84962K01	TAG, safety
	30-83586L01	CORD, coiled; 3 conductor
	41-83576L01	SPRING, strain relief
	4-1725	WASHER, flat; 0.266 × 0.562 × .040
	4-82707B01	WASHER, flat
	15-83572L01	HOUSING, microphone rear
	29-5247	LUG, soldering

note: For optimum performance, diodes, transistors, and integrated circuits must be ordered by Motorola part numbers.

COMMUNICATIONS SERVICE MONITOR

68P81069A69-O

MP MASTER

MA32830